THE

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NEW PLANT FOR OLD.

IN the notes on the reconstruction of a small station plant by Mr. Franklin L. Pope, read before the American Institution of Electrical Engineers, at the Niagara Falls, on June 27th, an endeavour was made to prove that he has successfully discovered the means of doing away with an old plant and replacing it by a new one with an expenditure compatible with commercial success, but without submitting sufficient data to enable one to arrive at a judgment as to the efficacy of his scheme.

In his opening remarks he dealt with the difficulties that have been created by the laying down of a disproportionate plant to the business that could reasonably be anticipated at that time, and with the heavy capital expenditure due to the high prices of machinery, which after all has proved unsuitable for its locality. He goes on to discuss the alternatives of relegating the old plant to the scrap heap, and substituting a new plant with modern machinery, new buildings and improved method of administration, and remarks, that when the necessary capital expenditure is readily forthcoming, there can be no doubt that this would often be the wisest course of procedure, but he wisely observes that for obvious reasons it is one which is not always, or even usually practicable—at least, so we find in England—and the indignation of the shareholders, bondholders, or its American equivalent, caused by their money disappearing to the junk shop or scrap pile, may be more easily imagined than described. The alternative of remodelling the existing plant, and bringing it as nearly as possible into accordance with the best modern practice, is evidently the favoured conclusion arrived at, and the way this desirable end is brought about is demonstrated in the case of the Great Barrington, Mass., Electric Light Company.

It appears that in the original plant laid down by this company, they wisely refrained from indulging in extravagant buildings, and placed their generating station alongside the railroad for the convenience of coaling. The original outfit was composed of low tension dynamos, and the station was placed about 600 yards from the centre of distribution. It is also reported that the plant, generally speaking, was well built, as things were in those days, and the original cost does not appear to have been very extravagant. The amount of business with which they began was evidently greatly augmented, for we find that in two years' time the plant was more than doubled, and a little later on more of the original plant was replaced by a modern type. On the whole, it seems that the progress of this company during the first two years, if maintained, would have led to a much more satisfactory condition of affairs, and we can only assume that for some reason or another, consumers were not obtained to the

extent expected after the additional plant had been installed. Is it possible that the admitted irregularity in the performance of the lights was responsible for this sudden fall in the expectations arrived at, the result being that they had placed on their hands a plant very much too large for the demand? To extricate themselves from this difficulty, resort was made to an entirely different system and methods of power, and whatever would have been the result of this departure, the fact of the abandonment of the old plant must have remained. We are not favoured with any figures showing the capital expenditure incurred in laying down the new plant, nor the sum realised from the sale of the old, but we are informed that after the money had been spent, and the plant put down, the minimum rental which they had to pay for the use of the new premises and machinery was somewhat less than the amount of the coal bill of the Great Barrington, Mass., Electric Light Company, of the preceding fiscal year; and, while the immediate saving in operating expenses was not large, it is stated that the new arrangements would place the company in a position to reduce its rates, for the reason that its output *might* be more readily increased without augmenting its operating expenses.

It is not stated whether the increased output was obtained after the new plant had been put down, or if the company found themselves in the same plight as before, viz., with plenty of power and plant, and not enough customers. At the finish they find themselves not the owners of a new plant, but renting the same from a manufacturing company, and also tied down to a monthly rental, based upon the actual output as measured in kilowatts at the dynamo terminals, provided that a certain minimum monthly consumption was guaranteed. The manufacturing company evidently knew what they were about when they stipulated that the rental should be based upon the actual output measured at the dynamo terminals. It is to be hoped that their lease was for a considerable number of years.

Mr. Pope gives us some interesting details as to the work during conversion, and no doubt they may been highly interesting to American engineers where they are allowed to hook their cables up to trees, or plant poles along the highway, or take short cuts across the country, and where they have waterfalls yielding several hundred horse-power for 12 months of the year, but to English engineers who are compelled to place their wires underground, the maintenance and replacing of "cracked or broken insulators on poles, and keeping the wires absolutely free from contact with uninsulated bodies" are problems which, luckily, they are not now called upon to solve.

It is interesting to note how things are done in different countries. In England, we find preference given to a number of units of plant including a sufficient amount of reserve to do the work. Mr. Pope prefers one large dynamo, which to us seems strange, as we cannot see how a continuous supply can be given without running it continuously, nor can we comprehend how it can compare in efficiency with the English method.

It is also strange that arc lamps with an aggregate of 54,000 candle-power were removed, to be replaced by incandescent lamps, whose aggregate was only 4,032, and that it was "admitted by all, that the streets of the town were much more satisfactorily lighted by incandescent lamps than they were formerly by the arc lamps." Our experience in England does not corroborate this.

It has been pointed out before in these columns that the financial conditions of small central electric lighting stations are not likely to improve rapidly so long as they are harnessed with heavy management expenses, and we think that the time is drawing near when we shall see a system of central management in operation, by which a number of small towns will be operated, so far as direction, management, and clerical business is concerned, from a common centre, the expenses being allocated to the different towns in proportion to the attention which they demand. The question, in cases where it is found impossible to do more than cover the cost of working expenses owing to over capitalisation, obsolete or inefficient plants, heavy depreciation, &c., whether the plant should be consigned to the scrap heap, and machinery of a more modern type substituted, or whether means should be taken to remodel the existing plant, and bring it as near as possible up to date, must be regulated to a large extent by the local conditions, and the amount of additional expenditure which would be involved in either case. We are inclined to think that a much more satisfactory arrangement would be to make use of the materials at hand, however imperfect.

Technical Research.

Our contemporary, *Engineering*, recently in an able leading article on technical research, discussed the various accelerating and retarding forces (chiefly the latter) which influence technical progress. As the writer aptly puts it "every engineer is engaged in technical research, sometimes at his own expense, but oftener at the expense of his clients." The ordinary problems are confided to the journeyman, but when several steps have to be taken into the unknown "then it is that the real art of the engineer—an instinctive power in adapting the forces of nature to new ends—comes into play." We would have thought reason was a better guide than instinct, when exploring the unknown. That, however, is a matter of opinion, but we think our contemporary airs a somewhat groundless grievance when throwing the blame for our slow progress on those objectionable persons who have invented our ideas beforehand, and on the patent law which will not give one a master patent for an idea which others have conceived but failed to bring into practice. An idea which has been published is public property, and one manufacturer has as much right to it as another. Any manufacturer, who by his own skill has made an old idea successful for the first time, will find that his patent will be treated by the courts in a very liberal spirit; he cannot in fairness expect to exclude others from doing the same thing in a different way. This may, however, have some deterrent effect in preventing manufacturers investing large sums in bringing old ideas to a successful issue, and points to the advisability of some kind of co-operative research such as has been carried out lately by the mechanical engineers. Our contemporary relies also on the professors at technical institutes doing something in this line, but the means at their disposal is usually inadequate, and it is doubtful whether they are sufficiently in touch with the practician to sympathise with and attack the problems whose solution is of most importance to him.

THE DESIGN OF TRANSFORMERS.

BY GEORGE ADAMS.

(*Continued from page* 87.)

The cost of copper increases in a greater ratio than the efficiency. A transformer with less than 24 turns may have a very fair efficiency, say, 96 per cent., and the cost of copper will be comparatively small.

In the example before us we will decide upon 14 as the number of secondary turns.

Then primary turns

$$t_1 = 14 \times \frac{2{,}000}{103} = 272.$$

We have allowed here a drop of 3 volts in secondary coil. By formula (7)

$$\text{F} = \frac{2{,}000 \times 100{,}000{,}000}{4{\cdot}45 \times 272 \times 100} = 1{,}652{,}400 \text{ lines.}$$

Now $\text{F} = \text{B A}$,

where B = induction in lines per square centimetre

A = sectional area of core in square centimetres.

A low induction should be decided upon because the iron losses which are always considerable vary as $\text{B}^{1{\cdot}6}$ and, therefore, increase very rapidly with an increase of induction.

The following formula due to Steinmetz is based on Ewing's experiments :—

Loss of energy in ergs per cubic centimetre of iron per cycle $= \eta \text{ B}^{1{\cdot}6}$ (8)

This loss is due to hysteresis only

η for thin soft sheet iron = ·0024

„ „ good „ „ = ·0030.

The following is Ewing's formula for eddy current losses :—

Watts wasted per cubic centimetre of core

$$= (n\, t\, \text{B}\, 10^{-8})^2 \qquad (9)$$

where n = frequency

t = thickness of core-plate in mils.

An inspection of formulæ (8) and (9) shows us why it is necessary to make the induction small. The iron loss amount in some cases to 75 per cent. of the total losses. From formula (9) we gather that the eddy current loss varies as the square of the induction, and this is an additional argument in favour of a low induction ; although the eddy current loss is of much less importance than the hysteresis loss, if the core-plates are thin, say not more than ·02 inches thick. In modern transformers the induction is usually between the limits of 2,000 and 4,000 lines per square centimetre. Continuing our calculations for the 10 kilowatt transformer, we will decide upon 2,500 as the induction.

Since $\text{F} = \text{B A}$

$$\text{A} = \frac{\text{F}}{\text{B}} = \frac{1{,}652{,}400}{2{,}500} = 661 \text{ square centimetres.}$$

Now, this is to be the net area of the core, and if we take 80 per cent. as solid iron, the remaining 20 per cent. being insulation, the gross area $\text{A}_g = 661 \times 1{\cdot}2 = 793$ square centimetres. From the peculiar form of the iron stampings, definite relations will exist among the dimensions ; thus, referring to fig. 4, $c = 3\,b$ and $a = 2\,b$.

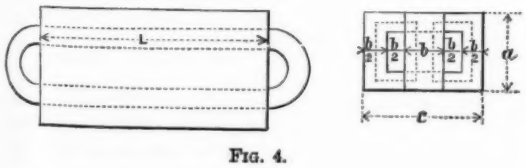


FIG. 4.

The length L varies in practice from about 4 to 10 times b. Adopting the symbol p to represent this multiplier,

$$\text{L} = p\, b.$$

Then $$b \times p\, b = \text{A}_g, \therefore p = \frac{\text{A}_g}{b^2} \qquad (10)$$

It is advisable to make p rather large, say 5 to 6, in order to reduce the length of the magnetic circuit.

The longer the magnetic circuit, the greater the open circuit current ; and for economical reasons the open circuit current should be reduced to a minimum. The mean length of the copper coil will be

$$2\,\text{L} + \left(b + \frac{b}{2}\right)\pi.$$

Also the total length of wire on the primary coil,

$$l_1 = \left[2\,\text{L} + \left(b + \frac{b}{2}\right)\pi\right] t_1,$$

but $\text{L} = p\, b$.

$$\therefore l_1 = 2\,p\,b\,t_1 + \tfrac{3}{2}\,b\,\pi\,t_1$$

$$\therefore p = \frac{l_1}{2\,b\,t_1} - \tfrac{3}{4}\,\pi \qquad (11)$$

But by equation (10) $p = \frac{\text{A}_g}{b^2}$.

$$\therefore \frac{\text{A}_g}{b^2} = \frac{l_1}{2\,b\,t_1} - \tfrac{3}{4}\,\pi$$

$$\therefore b^2 - \frac{2\,l_1\,b}{3\,t_1\,\pi} = -\tfrac{4}{3}\frac{\text{A}_g}{\pi}.$$

Solving the quadratic,

$$b = \frac{l_1}{3\,\pi\,t_1} \pm \sqrt{\frac{l_1^2 - 12\,\pi\,t_1^2\,\text{A}_g}{9\,\pi^2\,t_1^2}} \qquad (9)$$

an equation from which we can find, b, the breadth of the core, when we know the area of the core, A_g, the number of primary turns, and the length of wire in inches.

Proceeding with the 10 kilowatt transformer,

$$b = \frac{22{,}047}{3 \times 3{\cdot}14 \times 272}$$

$$\pm \sqrt{\frac{22{,}047 \times 22{,}047 - 12\,\pi \times 272 \times 272 \times 124}{9 \times 3{\cdot}14 \times 3{\cdot}14 \times 272 \times 272}}$$

$b = 8{\cdot}6 \pm \sqrt{21{\cdot}3}$, taking the negative sign,

$$b = 8{\cdot}6 - 4{\cdot}6 = 4 \text{ inches,}$$

we can now settle all the dimensions of the iron core. Referring to fig. 4,

$$a = 2\,b = 8 \text{ inches,}$$

$$c = 3\,b = 12 \text{ inches.}$$

The gross area of the core is 124 square inches, so that the length, L (fig. 4) will be $\frac{124}{4} = 31$ inches.

The secondary wire is to have 14 turns, and the mean length of the coil is

$$2 \times 31 + \frac{3}{2} \times 4 \times \frac{22}{7} = 81 \text{ inches.}$$

The length of secondary wire will be

$$\frac{81 \times 14}{12} = 94 \text{ feet } 6 \text{ inches,}$$

we must allow about 1 foot more than this for connections.

The secondary wire must carry a current of 100 ampères, at a current density of 900 ampères per square inch.

$\therefore$ Area of secondary wire = ·11 square inches.

A wire of rectangular section, ·64 × ·174 will have an area equal to ·11136 square inches, we may therefore use a wire this size.

Resistance of secondary

$$= \cdot000000703 \times \frac{1{,}134}{\cdot11136} = \cdot007 \text{ ohms.}$$

The space taken up by the wire,

— Secondary = ·66 × ·194 × 14 = 1·79 square inches.

Space occupied by primary wire,

= 272 × ·103 × ·103 = 2·9 square inches.

Aperture required for wire on each side of core,

= 2·9 + 1·79 = 4·68 square inches.

We have actually a space of 8 square inches, leaving a space of 3·32 square inches for insulation. This should be ample space.

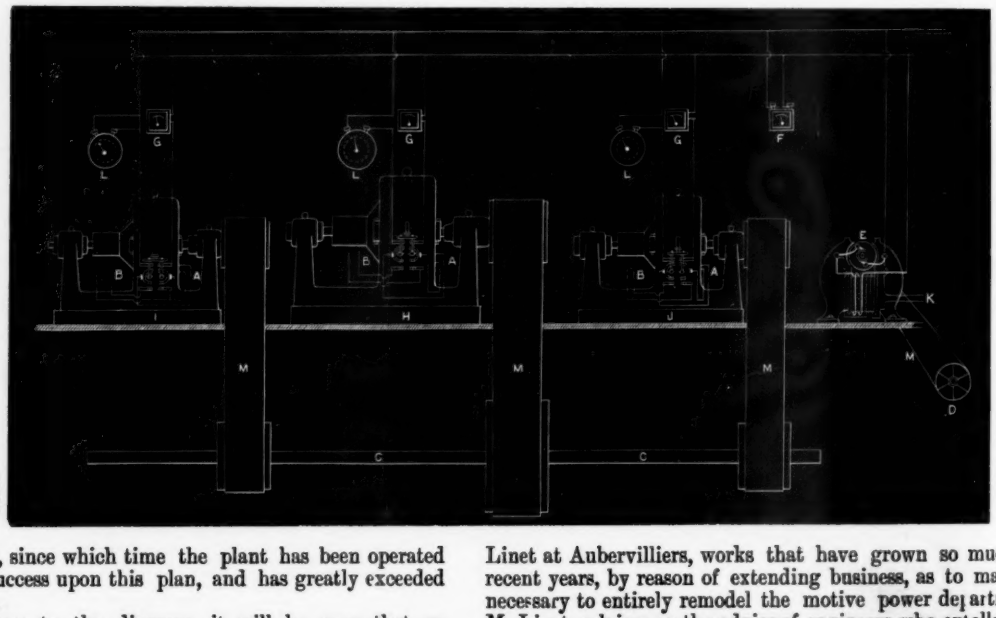
(*To be continued.*)

CANADIAN WATER-POWER AND ELECTRIC RAILWAY WORK.

The serious difficulties experienced in the operation of the water-driven plant of the Ottawa (Canada) Electric Railway were for the most part overcome, excepting with reference to the absolute steadiness of voltage, which it was desired should ultimately equal that of a steam-driven plant. The speeding up incident to a sudden withdrawal of work on the line was always necessarily followed by increased speed of the dynamos and E.M.F., and conversely frequent sudden demands for more power resulted in a check upon the armatures more or less violent. This also reduced the strength of fields, and largely contributed to the slowing up effect by neutralising the momentum of the driving machinery, which might otherwise carry the armature over these frequent light demands if the strength of field remained constant.

During the past winter Mr. T. Ahearn, Managing Director of the Ottawa Electric Railway, and a member of the well-known Canadian electrical firm of Ahearn & Soper, who built, and are the principal owners of the plant at Ottawa, decided that an independently driven water-wheel to operate an independent 500-volt dynamo, the current from which would be employed exclusively for the purpose of exciting the fields of his company's three street railway generators, would remove a multitude of variations of E.M.F. incident to self-excited water-driven dynamos. The necessary work to accomplish this result was completed in the latter part of January last, since which time the plant has been operated with great success upon this plan, and has greatly exceeded expectations.

A, To generator fields; B, To armature; C, Power driving shaft; D, Independent driving shaft for exciter; E, Exciter; F, Voltmeter; G, Ammeter; H, 700 horse-power; I, 400 horse-power; J, 400 horse power; K, To exciter rheostat; L, To generator rheostat; M, Driving belts.



By reference to the diagram, it will be seen that an ammeter is included in each dynamo field circuit, and placed upon each dynamo is a small double-throw switch, so that in the event of an accident to the exciting dynamo or its driving wheel the several dynamos could be self-excited by throwing the switch on each dynamo, which would connect the armature of each with its own field.

The three Westinghouse generators at Ottawa are one 700 H.P. and two 400 H.P., the total exciting current required for all three being less than 20 ampères.

Among the many advantages of this system are the following:—Steadiness of voltage, removal of the danger of burning out fields by abnormal armature speed, relief to the driving machinery, removal of fields from the line circuit, preventing any possible damage to them by lightning or other cause, the prevention of damage to commutators formerly caused by short circuits upon the line, throwing open the circuit breakers and short-circuiting the current across the commutator. These troubles are now entirely absent. Considerable time is also saved in throwing in dynamos, which is now done without delay after circuit breakers are reset. This formerly required a very considerable time in synchronising fields.

The splendid success which has attended the operation of this water plant in Canada should recommend it to the serious consideration of the owners of water power plants in America, which are already numerous, and will always be increasing in number. And there is no doubt that those interested, who may attend the coming Convention of the Street Railway Association at Montreal in October next, will visit Ottawa to personally inspect this valuable means of removing defects and annoyances incident to the operation of electric railways by water power. Ottawa is but $3\frac{1}{2}$ hours by rail from Montreal, and in addition to its being the capital of the Dominion, is a city of 50,000 live people, who boast of having an incandescent lighting installation of one lamp for each head of population, and an electric railway of 30 miles of track operating 40 cars daily, which in the matter of service and equipment is unsurpassed.

Ottawa is recognised as electrically of the first importance, and also enjoys the proud distinction of having first solved the snow problem, demonstrating that an uninterrupted electric street railway service could be successfully maintained throughout a Canadian winter.

PRODUCER GAS MOTORS AND ELECTRICAL POWER TRANSMISSION.

L'Industrie Electrique records what it rightly terms a remarkable application of electrical driving of machinery at the very gates of Paris, in the chemical manure works of M. Paul Linet at Aubervilliers, works that have grown so much in recent years, by reason of extending business, as to make it necessary to entirely remodel the motive power department. M. Linet, relying on the advice of engineers who extolled the use of producer gas engines, and anxious to maintain himself in line with the progress of modern mechanics, has not hesitated to face the outlay necessary to instal a complete plant for electrical transmission, and it can be said without hesitation that this installation constitutes a model, as well from an economical point of view as in the perfection of the special details and fittings.

The special industry carried on at Aubervilliers gives rise to much dust, and is carried on over a large area of ground, and the cost of ordinary means of transmission and their maintenance in good order is very great. Hence the decision to employ electricity, which, with other advantages, would suppress such other means, and would be more easily handled, and render a better efficiency. Applications of electrical transmission already made in dusty places appeared to show good results, and to work without serious inconvenience.

The motive power *par excellence* was clearly indicated as the producer gas engines of the simplex type of MM. Ed. Delamare-Debouttville et Malandin, supplied by a battery of gas producers of the type Buire-Lencauchez. MM. Matter et Cie., of Rouen, the makers, were also charged with the connections to the dynamos, which, with the electrical work generally, were entrusted to the Maison Gramme, who also installed a special lighting plant.

There are three simplex engines of 80 H.P. each, capable of running alone, or together, as required by the needs of manufacture. Each drives a generator through a shaft placed below the floor, which also actuates the lighting dynamo and the pump of the artesian well. Two gas producers, worked alone or in parallel, feed the motors, the gas passing to a holder through a washer, cooler, and purifier.

The complete installation at present consists of three gas engines and two steam engines, of which one worked before the gas engines were put down, and the second will be displaced when all the machines have received their equipment of electricity—three power and one lighting dynamo, and the well pump. It was necessary to be able to drive one of the four dynamos and the pump by means of either any gas engine, or by the first-named steam engine, or two, three, or four dynamos, and the pump by means of any two, three, or four motors, excepting the second steam engine, which is too feeble. Further, each dynamo must be capable of running alone. To fulfil all these conditions, it was necessary to have the means of placing together or independently :—

(*a*) All the motors and their particular shaft length.

(*b*) All the dynamos and their particular gear.

(*c*) Each special shaft length to the motors of the other lengths of shafting.

Two lines of shafting were alone possible, because of the space available, and the final disposition of machinery was as follows :—On one side the two steam engines and the pump, then a line of shafting carrying two special couplings, easily and quickly engaged or disengaged ; next the three gas engines, and finally a second line shaft in three coupled lengths, the lines of shafting being below the floor, and the three dynamos almost over the second line of shafting. In a very small space this arrangement secures the ends aimed at, the two shafts being capable of running together by a belt, and their tri-partition enabling the various necessary combinations to be effected. The installation of electricity by the Maison Gramme was intended to consist of three dynamos of 56,000 watts each, and of a score of motors of different powers from 4,000 to 15,000 watts, and of one lighting dynamo of 56,000 watts for arc and incandescent lamps.

The actual installation consists of one generator and five to six motors, and of the lighting dynamo which feeds a number of regulators and lamps varying greatly with the needs of the establishment. The generator is a compound machine of 450 ampères capacity at 125 volts. The lighting dynamo is of the same power, shunt wound, and capable of running up to 165 volts, so as to be suitable for charging a battery of accumulators, whose installation had been intended. The two machines are of the 6-pole Gramme type, and run at 360 per minute.

The electric motors placed in various parts of the works are of bi-polar Gramme type, also shunt wound, and constructed for constant speed at all powers. The brushes are of carbon.

The efficiencies of the dynamos have been determined on a method employed by the naval and military authorities. The efficiencies of three dynamos are as follows :—

At 450 ampères	...	...	...	91	per cent.
„ 350	„	...	...	...	90	„
„ 300	„	...	...	...	88	„
„ 200	„	...	...	...	82	„
„ 130	„	...	...	...	77·5	„

The efficiency of the motors as shown by the brake was 86 to 89 per cent.

By suitable connections, each generator can be made to supply any motor at any part of the works, and the distribution of light is also organised to fulfil similarly elastic conditions, so utilising to the best advantage the motive power under all circumstances.

The switchboard is of white marble and carries all instruments necessary to facilitate the control of the service and assure the good working of the whole installation, in particular automatic recorders of current, and of the running of the motors and current meters arranged to be quickly placed in any circuit. Particular care is taken to insure the best starting and stopping of the motors in spite of the difficulties these operations involve, both by reason of the nature of the machines to be driven, and of the little care to be expected from the workers themselves. The machine room is served by a traveller.

In order to test the electrical equipment at full load before the works were ready, as also the gas plant, recourse was had to water electrolysis, whereby steady load can be secured, and effects observed at leisure, not possible to be observed under the ordinary conditions of a manufacturing establishment.

Such a trial was made, lasting 10 hours consecutively, and showed plainly the good running of the whole installation, the gas producers, motors, shafting, and dynamos :—

	H.P.
Mean power of motor	71
Maximum, ditto	86
Revolutions per minute (mean)	123
„ „ (maxima)	124
„ „ (minima)	120
„ „ dynamo (mean) ...	378

(Mean duty, 371 ampères 124 volts.)

A brake trial of the motor was then made. The brake was of rope, 30 mm. diameter, applied on the fly-wheel, the rope being restrained by a spring balance at one end and a weight at the other. Water-cooling prevented overheating of the brake rim. Speed was measured by a counter driven off the valve shaft, while the number of explosions was recorded by means of a counter actuated electrically by the opening of the gas admission valve. Crossley indicators were used, the springs being carefully checked, and the pencil was run five or six times round the card for each indication, and the mean pressure determined from a number of cards sufficient to secure practical exactness of power. The cylinder was gauged for diameter. An examination of the cards gives some idea of the behaviour in the cylinder, and the action of the regulator of MM. Delamare-Debouttville et Malandin, and they are, says our contemporary, an interesting study. They prove that the mode of regulation is excellent as a means of sparing all parts directly connected to the piston, and avoiding cost of up-keep by extending their life.

The consumption of coal was determined by first running the motor until it had reached the normal condition which it should attain and preserve. Next the producer was cleaned and filled up with fresh fuel, and such as was still good of that removed. Subsequent fuel was all weighed during the test in sacks, and after a given time, the producer was again cleaned and filled with the weighed fuel and what again remained of the last charge.

The total of new fuel going into the producer in the course of the trial is the weight consumed. The gas holder index was read carefully before and after the trial, care being taken to bring it round to the starting point. The motor did not vary 5 per cent. from its proper speed.

The following are the data and results :—

Cylinder diameter	581 mm.
Cylinder stroke	760 „
Total fuel used	232 k.
Length of trial	4·19 hours.
Speed of motor per minute	120 220
Brake horse-power	81 42
Indicated horse-power	105 81
Efficiency	0 769
Fuel consumed per hour	53 780
Fuel consumed per brake horse hour ...	·661 k.
Fuel consumed per indicated horse hour ...	·508 k.

The last two figures represent less than 1½ lbs. per brake horse-hour, and only 1·12 per I.H.P., while, if we include the results of a small motor, the joint figure is only 1·078 lbs. per H.P. hour. The horse-power is, we may conclude, the French horse-power of 32,548 foot-pounds, so that the above weights of fuel should be increased nearly 1½ per cent. for English horse-power. Practically 1½ lbs. per I.H.P. hour is here recorded—a figure which will show very different annual costs to those put forward by Mr. Bollinckx in his estimates of costs for producer gas as compared with steam, and there appears to be now a considerable accumulation of producer gas results to support the claim that gas engines are certainly cheaper to work than steam engines, while they avoid the danger of the steam boiler. The question of durability alone seems now to be the one point at issue. Will the economy of the gas engine over-balance the cost of repairs, though so far there is no special evidence that ignition tube engines are particularly heavy in repair. The old Crossley engine with its slide valve was always going wrong, and must have been a fortune to its makers in repairs alone, but no one uses slide valve ignition now, and gas engines are improving daily.

THE ACTION IN THE BOYNTON MULTIVOLT BATTERY.*

BY WM. A. ANTHONY.

I NOTICE in recent issues several communications in relation to the Boynton multivolt cell. Mr. Johonnot in the *Engineer* of June 12th, attempts to give the theory of the battery, and ignores entirely the fact that there are potential differences between the several carbons and also between the several zincs, as well as between zinc and carbon; and his theory, therefore, leads him to totally errroneous conclusions.

Prof. Carhart, in the same issue comes much nearer the truth, but in stating that "the most important leakage or waste current is between the zinc of cell 1 and the carbon of cell 3" (see accompanying fig. 1), he overlooks the E.M.F.

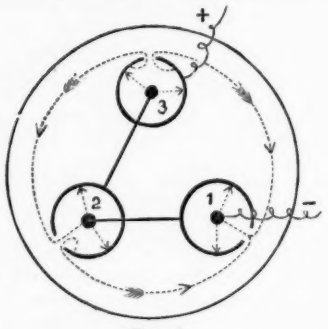


FIG. 1.

of the cell. There is a difference of potential between the carbon of cell 1 and the zinc of cell 1, the carbon being +, and yet, when the cell is in action, current flows through the liquid *from zinc to carbon* against the potential difference. There is, therefore, no greater *effective* potential difference between the zinc of cell 1 and the carbon of cell 3, than between the carbons of those two cells.

It is true that I did not allude to the fact that with a low external resistance the leakage would be small, but with a low external resistance this battery would be a very inefficient

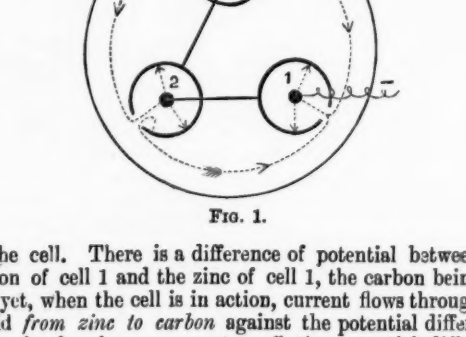


FIG. 2.

combination. The elements for such use should be joined in multiple and not in series. When joined to produce a "multivolt" battery, its purpose would be to overcome a considerable resistance.

Now, as to the leakage, let the connections between the different elements be broken and the resistance of the liquid

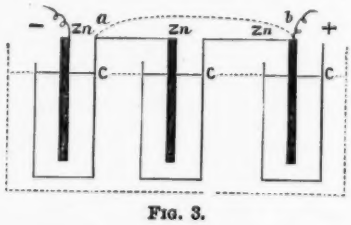


FIG. 3.

from carbon to carbon, just as they stand, be measured. From the data given in the description of this battery in the issue of May 15th, that the E.M.F. on open circuit was 5⅙th volts, and the current on short circuit 5 ampères, I deduce the resistance from carbon to carbon as equal to about 3 ohms.

* New York *Electrical Engineer*.

Referring to my figure, page 484, of May 29th, which is reproduced here in fig. 2, would it be considered good practice to connect the first and third carbons of a battery of three cells by a wire of 3 ohms resistance as shown by the dotted line, *a b*, fig 3? Yet this is exactly what is done when the three elements are immersed in liquid in one cell. And what is gained by it? Nothing, except the facility in handling a gallon or two of liquid contained in one cell instead of three; and I venture to say, in consequence of the local actions, it will need to be replaced twice as often in the one cell.

I arrive at the resistance given above as follows. The E.M.F. of a zinc carbon bichromate cell is given as more than 2 volts. The potential difference between the terminals of a battery of three well insulated cells in series would on open circuit be more than 6 volts, whereas the Boynton cell gives only 5⅙ volts. This loss is due to the short-circuiting effect of the leakage upon two of the cells, exactly as would occur if a conductor joined the points, *a* and *b*, as shown by the dotted line in the figure. Assuming the full potential difference of 2 volts for the last cell, the two short-circuited cells give only 3⅙ instead of 4 volts, and this would be the case if the short-circuit was a little less than four times the internal resistance of the two cells. It is stated that the battery on short-circuit gives about 5 ampères; this means that its internal resistance is about 1 ohm, that is, ⅓ ohm per element. Four times the resistance of two cells would be less than 3 ohms for the leakage path. This seems small if the outside of the carbons is perfectly insulated, but it cannot be far from the truth unless I have over-estimated the E.M.F. of the element. If this leakage path has such a low resistance it means a leakage current of 1 ampère—as large as the useful current that should be taken from a battery of such dimensions if it is to be used with any regard for efficiency.

NEW FORMS OF FRICTION BRAKES.*

BY W. F. M. GOSS.

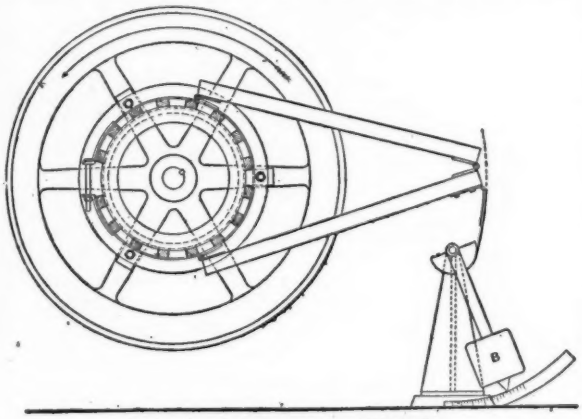
THE terms "friction brake" and "absorption dynamometer" are often used interchangeably, but obviously their meaning is not the same. The purpose of a friction brake is to absorb power; that of an absorption dynamometer, to absorb and also to measure power. Thus, the mechanism which is commonly employed to check the speed of railway trains constitutes a system of friction brakes, while the so-called "Prony brake," though none the less a brake, may properly be termed an absorption dynamometer. In its ultimate analysis, every absorption dynamometer embodies the elements of a friction brake, the former term including the latter, but all friction brakes are not absorption dynamometers.

In an experimental laboratory, equipped with steam engines and other motors, the usefulness of the several machines depends largely upon the constancy of the resistance against which they are made to work. This resistance, or load, must usually be supplied by some form of friction brake, and thus it is that apparatus of this class becomes an important factor in experimental work. The ideal brake should be capable of working under any load, from none at all up to the maximum for which it is designed; when set for a given load it should be able to supply it for an infinite period, without variation; its action should not expose attendants to discomfort or danger; and, if possible, it should not be expensive either in first cost or in maintenance. The ideal absorption dynamometer must add to these attributes some reliable means by which the amount of power absorbed in a given time may be observed or automatically recorded. It is true that ideal conditions are not always necessary to satisfactory results, but, on the other hand, it must be admitted that the average friction brake does not meet requirements which are both reasonable and necessary. In the laboratory at Purdue there are now fifteen brakes, which together are capable of absorbing more than a thousand horse-power. In providing these brakes, no effort has been made to avoid multiplying forms, for the

* Read at the Detroit meeting (June, 1895) of the American Society of Mechanical Engineers.

brakes, as well as the machines to which they are attached, constitute pieces of apparatus for the use of students, and, other things being equal, the greater the variety the better. None of these brakes fulfils all of the ideal conditions already set forth, but it is believed that each one described possesses sufficient merit to warrant its mention.

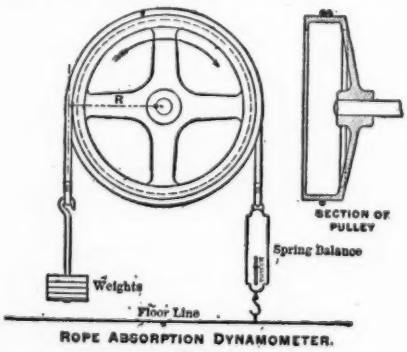
Pendulum Absorption-Dynamometer.—Prony brakes of simple form often give trouble by a vibration of the arm, which interferes with accurate observations of the load. This vibration may readily be controlled by the application of a dash pot, or, probably with less expense and much more success, by making the brake arm a pendulum, with a heavy bob at the end, after the plan of a Thurston oil tester, and so proportioning the parts that the mass of the whole is sufficient to absorb, by its inertia, the forces tending to produce vibration. So far as the writer is informed, no large brakes have ever been constructed on this plan, but a modification of it has been carried out in the case of two 10-horse-power brakes at Purdue. One of these, the details of which were designed by Mr. Richard A. Smart, junior member of the Society, is shown by fig. 1, attached to an Otto gas engine. It will be seen that as the brake arm rises it displaces the pendulum, B, against the action of gravity, thus furnishing a load which increases with the movement of the arm. The pendulum moves freely, but does not vibrate under the action of the forces transmitted by the brake arm.



PENDULUM ABSORPTION DYNAMOMETER.
FIG. 1.

The curved scale under the pendulum bob is graduated experimentally in terms of horse-power per 100 revolutions. The whole arrangement is very convenient and effective, its accuracy being all that is required for the purpose for which it is used.

Rope Absorption-Dynamometer.—The fact that a wrapping of rope around a wheel will serve to absorb and to measure power is by no means new, but it is doubtful whether the great merit of the rope dynamometer is appreciated except by those who have used it, or, indeed, whether the application of the principle it embodies is generally understood.



ROPE ABSORPTION DYNAMOMETER.
FIG. 2.

The common arrangement of a rope dynamometer, which is shown in fig. 2, represents one of several small dynamometers in daily use at Purdue. The wheel of this brake is provided with inside flanges, between which, when running, a small quantity of water is held. A piece of manilla rope placed over or wrapped around this wheel is attached at one end to a spring balance secured to a fixed point, and at the other end it sustains a weight. Friction neglected, it may be assumed that, when the wheel is at rest, the reading of the spring balance on one side will be equal to the value of the weight on the other side. When the wheel is in motion, however, it tends to carry the rope around with it; the weight is then raised, and rope is fed over to the balance, reducing the tension on the latter. The condition of the rope is similar to that of a belt which is transmitting power; it has its tight side and its slack side, the former being connected with the weight and the latter connected with the spring balance. The effective brake load is the difference in stress on the two sides of the rope, and the effective radius, the distance R.* It will be seen also, that if for any reason the slack side becomes too slack, the weight on the other side will not be sustained, but will fall back, thus increasing the tension on the spring balance, which increased tension, in turn, will at once tend to restore equilibrium. By varying the number of turns of rope on the wheel, the weight on the tight side may be large, and the reading of the spring balance relatively very small, a condition which greatly favours the maintenance of a constant resistance. A rope dynamometer never sticks, and it cannot suddenly lose its grip. Its steadiness in action, and the constancy with which it maintains a given resistance, are features greatly to be desired in any brake.

In the design of the brakes which remain to be described, an effort has been made to secure the elements which give stability to the rope dynamometer; to adapt these elements to conditions where, in its simple form, the rope dynamometer would not serve; and in each case to make the whole brake a piece of apparatus possessing greater permanency. In these brakes, also, the plan usually followed, of making wooden shoes bear on an iron wheel, has been reversed, and iron bands have been made to bear on wooden wheels.

(To be continued)

THE NIAGARA MEETING OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

THE four days' meeting of the American Institute, which was opened at Niagara on June 25th, seems to have been as successful a gathering as any that Institute has had. Undoubtedly the great attraction was the Niagara Falls transmission plant, which the members inspected in a body, and into all the details of which they were permitted to examine, every facility being placed at their disposal for that purpose. The actual attendance of members was nearly double that of last year's gathering.

In our issue for July 5th we published a list of the papers which were read, and these, independent of the Niagara attraction, would have made a most interesting meeting. The president for the year was Dr. Louis Duncan, who, in the evening of the first day, delivered his inaugural address, taking for his subject a matter which is perhaps of more practical interest to American electrical and railway men at the moment than anything else, *i.e.*, the substitution of electricity for steam in railway practice. The question is receiving much consideration on this side of the Atlantic, but is of far more immediate importance in the States, several schemes being in active progress there whereby steam locomotives will be superseded by electric; while here, and on Continental Europe, we are, comparatively speaking, just thinking the matter over. An American exchange considers the address, "without doubt, the best and ablest discussion on this most important subject of the day." Three questions were faced by Dr. Duncan, *i.e.*:—

1. Given a railway system at present operated by steam; will it pay to change entirely to electricity, or to make a partial substitution, and how should the change be made?
2. If entirely new lines are to be built, is it likely that it will pay to equip them electrically? How should they be equipped?

* The work done in a single revolution is $2 \pi R W$ and the horse-power is $\frac{2 \pi R W N}{33{,}000}$, where R is the effective radius in feet, W, the effective load (weight, minus the reading of the spring balance), and N is the number of revolutions per minute.

3. I will describe the equipment of the B. and O. tunnel plant, and draw from it what morals I can.

In his address, the President reasoned as to what really are the proper applications and limitations of electricity for existing steam roads. His address was one of neither the electrical enthusiast nor the steam railway pessimist. He attacked the problem fairly, from the standpoint of a

railway engineer, who is perfectly familiar with what had been accomplished by electricity for traction purposes, and who is anxious to make use of it as far as he can be sure it would be of advantage to stockholders, but no farther.

The conclusions at which Dr. Duncan arrived are :—

1. The tendency of passenger transportation on the steam lines has been in the direction of the greatest electrical economy, while the tendency of the freight transportation has been in the direction of the least electrical economy.
2. It will not pay any through line with considerable traffic, having two tracks, to equip their main tracks electrically.
3. With four track roads it will pay to equip all of the tracks electrically, unless a considerable portion of the business is through passenger traffic.
4. It will pay all the larger roads either to equip a number of their branch lines electrically, or to control competing electric lines.
5. In order to remain on a dividend paying basis, it is imperative that most of the two track lines either build additional tracks, or control the electric roads that parallel them.
6. Believing that ultimately all of the traffic will be done by electricity, it is imperative that the managers of steam roads keep constantly in touch with electrical progress.

In the discussion which followed, Mr. Steinmetz stated that alternating current motors may now be used for operating railways, and are even better for that purpose than continuous-current motors.

We referred to Dr. Duncan's address, to some extent, in the leader of last week.

Another subject which is also of immediate interest alike on both sides of the Atlantic, was that dealt with by Prof. F. B. Crocker, V. M. Benedikt, and A. F. Ormsbee, *i.e.*, "Electric Power in Factories and Mills," the many advantages of electric power in this branch of work being enumerated. Mr. Steinmetz dealt with alternating current work, Profs. Jackson and Fortenbaugh with recent tests of a monocyclic alternator; Dr. Emery gave a paper on the "Cost of Steam Power," and a discourse on the cause of death in electric shock which was delivered by Dr. A. M. Bleile, appears elsewhere in this issue. Mr. G. H. Winslow took as his subject the Pomona, Cal., high voltage alternating plant, the title being "Long Distance Transmission at 10,000 Volts." The final paper of the session, and one which doubtless interested the members more than any other, was that of Mr. W. L. R. Emmett on "The Existing Commercial Applications of Electrical Power from Niagara Falls."

We hope electrical men in this country will give us some good and practical papers at the British Association meeting in September. Such a meeting as that held at Niagara, of the American Institute, shows how much we are behind our United States *confrères* in this direction.

CORRESPONDENCE.

International Electric Storage Batteries.

Your article headed as above in the current number of your journal appears to me to call for a few remarks, although the "capacity" of the column and a quarter, as also its "E.M.F.," is to my mind very low.

I am bound to confess that I have not, so far, realised the fact (?) that "the management of the E.P.S. Company have been aware that, by slight modification of their present pattern, cells can be made having a much larger capacity with less weight than those which at present they put on the market," as otherwise I should have expected to have been able in the past to have obtained accumulators from them more suitable for the demand, and especially for traction work. As regards lasting powers, this is such a very important item, and one which has been particularly conspicuous by its absence in any traction E.P.S. batteries that I am aware of, that it is almost ridiculous to call cells having plates with much less lasting powers practical accumulators at all.

I have not the slightest doubt in my own mind that if the E.P.S. Company, or any other accumulator manufacturers, had possessed the knowledge which you attribute to them, and had been able to obtain anything approaching the lasting powers, which are one of the chief features of the I.E.S. accumulators, they would not only have made their own fortunes, but would also have succeeded in introducing electrical traction on tramways in the United Kingdom with their cells to a very considerable extent.

Referring to the next clause in the article, I considered when I wrote the paper referred to that my readers would have understood what I meant by "with the present amount of practical experience," but for the benefit of any of your readers who may construe this in the same light as you do, I will explain that I did not intend to convey the impression that, in my opinion, the I.E.S. batteries were *perfection*, but only that, with present limitations (such as the comparatively small range of materials obtainable at the present time having the necessary qualities and properties needful for the work), such an enormous stride had been taken in the progress of electrical storage, that temporary perfection for traction work appeared to me arrived at. Your question as to who has the existing amount of practical experience is almost too childish for serious notice.

The *one* point which you raise, and which is a reasonable criticism to expect from a technical man hitherto unacquainted with these batteries, is that of the reducing of the active surface by means of the celluloid. After very careful tests I have found that the presence of this celluloid envelope makes no appreciable difference in internal resistance, and makes absolutely no difference as regards electrolytic action on the surfaces so covered, since the acid is present between the electrolyte and the envelope. This explanation, which may be instructive, will show that there is no inconsistency such as suggested by you.

You seem to imply that tests made by myself were few, hurried, and directly with the object of placing a paper before the Tramways Institute; it may therefore be as well to save your valuable space by stating briefly that tests have been carried out by me, and for me, and by many others whose results I have obtained with plates unformed, plates fully formed, plates partly formed, plates which have been subjected to heavy charges and discharges, and plates which have been subjected to only low rates, and that consequently the brief statement which I placed before the Tramways Institute gives facts which I considered of special interest to them, and shows the complete opinion which I have formed after careful and exhaustive experiments.

The two last paragraphs in your article are, to my mind so extraordinary, that I can only wonder who you have come in contact with who have any large practice in secondary battery work (especially for traction purposes), and whether the writer of your article has ever himself taken charge of a battery of E.P.S. accumulators which has been used for heavy discharges, or subjected to any shaking or rough treatment. I only wish that my own experience with their accumulators had been in accordance with the impression conveyed in your article as being your own, because I should then have been able to carry out work which I have not been able to touch in consequence of the impossibility of obtaining in the past a suitable accumulator for these purposes. I would ask all electrical engineers reading this letter, "Does your experience bear out the remarks contained in the two last paragraphs of the article to which this letter refers?" I feel sure the answer would invariably be "No" from any who hold no "brief" for the E.P.S. Company.

It has been a matter of very great importance to my firm for the last two years to obtain a really light and efficient accumulator for use with our patent electric rudder motor, and it has only been through obtaining I.E.S. batteries that we have been enabled to place this invention so satisfactorily on the market.

You will readily understand that, in connection with this particular work alone, my practical experience with accumulators has not been slight.

Only last week we were able to run from Maidenhead to Kingston without re-charging, with two boxes of batteries (12 cells), weighing about 100 lbs. each, and giving 20 ampères during the 7 hours' run, and at the end of this time the accumulators had not dropped below 1·8 volts per cell.

I cannot conceive the possibility of your not realising

from this result alone the enormous difference between these batteries and others on the market. I may add that the accumulators used in this trip have been in constant use for the past four months.

Anthony G. New.

July 18th.

[The above does not in any material way affect the remarks made in our article. The one point which Mr. New explains with reference to the celluloid envelope makes us inclined to doubt if his experiments have been very thorough, or surely he would have found that even if acid was at some time present between the active material and the envelope it certainly would not remain acid for very long.

After all it is merely a question of practical experience, but Mr. New is altogether silent on this point. The last paragraph but one does not convey any definite information, as Mr. New does not state the size of boat or the number of people carried.

We are in no way holding a brief for the E.P.S. Company, as Mr. New apparently suggests, but are merely anxious to get at facts; we should also be glad to have the opinions of others, as suggested by him.—Eds. Elec. Rev.]

"Old Insulators" versus "Natural Conclusions."

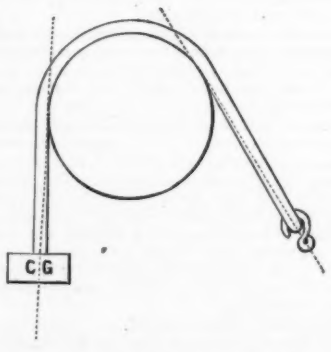
When you find a civil engineer hard at work upon an invention for bringing down the moon, you may conclude that he is a l——; or when you discover an electrical engineer scratching his head and gazing at a switchboard that he has just connected up, you may conclude that he dunno — — —; or when you find telephone linesmen seated round a barrow and pouring something from a can into an inverted insulator you may conclude that the *something* is not s——; or, again, when you find Policeman No. 8 coming out of a dark entry and wiping his mouth with the back of his hand, you may (regardless of his "wire gauge" or his "static capacity") conclude that he has been having a r——; or, finally, when you find a latchkey hole severely scratched within a radius of three inches you may conclude that the master of the household belongs to a c——.

I would not have mentioned these little facts in "Natural Conclusions" but for a letter from an old friend of mine in your last week's issue.

W. J. M. M.

Rope Brake for Engine Testing.

I notice in your last issue in referring to the rope brake for engine testing, you make the remark, "we believe the circumference of revolution is sometimes taken as the external surface of the rim on which the rope bears in place of being measured at the middle of the rope thickness."



I think you have overlooked the fact that with a flexible rope the centre of gravity of the weight will place itself vertically under the point of suspension, which is on the surface of the rim, and that the pull of the spring balance will likewise always act in a line tangential to the surface of the rim. It is therefore perfectly correct to take the circumference of the bearing surface as the circumference of revolution: the thickness of the rope makes no difference whatever.

E. G. Herbert, B.Sc.

PROPOSED ELECTRIC LIGHTING OF VICTORIA EMBANKMENT AND WATERLOO AND WESTMINSTER BRIDGES.

The report of the Highways Committee of the London County Council with reference to the lighting of the Thames Embankment and bridges (which appeared in our last week's issue) came up again at the weekly meeting of the Council on Tuesday, the recommendation before the Council being "that, subject to an estimate being submitted to the Council by the Finance Committee as required by the statute, the Highways Committee be authorised to take all the necessary measures for establishing, at a cost not exceeding £16,590, electric lighting for the Victoria Embankment and the Waterloo and Westminster bridges (but exclusive of the Embankment Gardens), authorised by the Council's (General Powers) Act, 1893, and that for this purpose the committee be authorised to obtain tenders and to enter into contracts on behalf of the Council."

Mr. J. Thornton said he rose to move the amendment which stood in his name, which was: "That the Highways Committee be instructed to obtain reports from the engineer and the chemist upon the question whether the lighting of the Victoria Embankment and the bridges could be improved by the substitution of incandescent burners for those at present in use." At present they had no information before them that the light would not be better than the electric light; but in the case of a private consumer, it had come to his knowledge that the incandescent burner consumed one-third less gas than the ordinary burner, and if that was so, it surely would indicate that for the same price they were now paying they could greatly increase the lighting power by the substitution of the incandescent burner. Of course, the question was raised as to whether this particular burner would be a suitable one; but the Council should have some information before it. To make his amendment more effective, he would add the words: "That the report be referred back for the Highways Committee to consider and obtain reports from the engineer, &c."

The Earl of Onslow said that he would have pleasure in seconding the resolution. He had the advantage of living close to the Embankment, and knew something of the lighting. He very much doubted whether so large an expenditure as was proposed by the committee was justifiable. The traffic on the Embankment was of two kinds. There was, first, the vehicular traffic, which was not at any time excessive, and which in the evening, at the time when the electric light would be required, it ceased almost altogether, because the Embankment was the great artery between the West End and the City, and in the City at night, as they knew, business was at a standstill. The other class of traffic was pedestrian, and pedestrians used it for the purpose of promenading, and he certainly would not welcome a very heavy electric light, for, in his case, a quiet walk by the silvery Thames was far better than the brilliant glare of Piccadilly. Before they ran into that expenditure for the benefit of a district which could not be considered to be poverty-stricken, they should refer the matter back to the committee, in order to consider the proposal made by Mr. Thornton, and he would go a step further, and express the hope that they should also consider the third alternative, and get from the private companies on what terms they would be prepared to light the Embankment by electricity.

Mr. Hoare said that it was often his lot to come away from his office late, and it was much pleasanter to walk along the Embankment than along brilliantly-lighted Queen Victoria Street. There was ample light at present provided by the gas, and he expressed the opinion of a large number of people that the Embankment should remain lighted as it was. He thought it would be a waste of money to carry out the recommendation.

Lieut.-Col. Ford said it was unfortunate that new members of the Council, before opposing the proposition of the committee, did not take some trouble to investigate the history of the question. He happened to know that the committee had given an infinite amount of pains to the matter. From what they had heard, one would suppose that the only question was the lighting of the Embankment, but there was a much more important aspect, which was that they were asked to light two important bridges. He spoke for thousands of working people who used the bridges. The chairman of the Finance Committee told them the expenditure was not necessary, but he saw in one asylum they were spending £21,000 for lighting it by electricity, and if they could spend £21,000 for a single building, surely they could spend a smaller sum to light the principal thoroughfares of their own city. With regard to the mover of the amendment, they would suppose the question of lighting the bridges with gas had not been considered. It had been considered very carefully in 1893, and the committee came to the conclusion that the better way was to light the bridges and the Embankment by electricity. In some of the smallest municipalities electricity was used for lighting the highways. They had a report addressed to the Highways Committee by the engineer, and he said that nothing could compare with the brilliant light given by electricity. There was also a report of the engineer to the Bridges Committee, which would give them the information they wanted. Seeing that the Council got the Act in 1892, he thought it was quite time they did something.

Mr. Jones said that two of the previous speakers said the Embankment was well lighted at the present time. He did not think that was the opinion of the people of London. One speaker alluded to the contrast between the Strand and the dim light of the Victoria Embankment. That showed the danger of the place being badly lighted. With reference to the incandescent light, he thought it had been successful in many places. In a large business place with which he was connected it had answered admirably, but out of doors it was a question whether it would do, and as far as Westminster

Bridge and Waterloo Bridge was concerned, he thought it would not answer at all. The situation was too exposed, and the wind would be too great. In Kensington and other places they found that the vibration of the traffic interfered with the delicacy of the incandescent burners. He had no objection to trying the experiment, because it would give them more time in which to clear the trees before putting up the light.

Colonel Rotton said that he had used the incandescent lamps for some time, and he thought the light given was much stronger than the electric light up to the same power. That was of great importance, and would knock the argument, of those who objected to the incandescent light on the ground that it was not powerful enough, on the head. The consumption of gas was much reduced by the use of those burners—in his own case his gas bill was much smaller. The difficulty of the vibration of the traffic interfering with the light had been got over. Then the cost of maintaining would be much less. He trusted the report would go back, because under any circumstances it was too late for them to light the Embankment with electricity that winter.

Mr. Beachcroft said there was no doubt that the streets of London were the worst lighted in the world. He thought the questions raised were pertinent, and he hoped the committee would give them more information. He happened to read the other day that it was now an established fact that the incandescent gas light system had treble the lighting power of the ordinary burner with half the consumption of gas. If that be so, it would be worth while to have a report prepared as to the substitution of incandescent gas burners for electricity. They were asked to spend £12,300 to establish the electric light, and seeing that there were at least four companies in the surrounding areas, all of which would be only too ready to supply it, he thought it only right that the Council should have some information before them on that particular subject. He believed the cost of lighting the Embankment and two bridges by gas was £1,800 a year, and they were told the annual cost of the electric light would be £2,765. That struck him as a very large increase upon the cost of gas. Experience told them that the incandescent gas light was equal to three times the present light, and surely it was worth while having some information on that point.

Mr. Hubbard, replying as chairman of the committee, said that the question had been before the Council since 1892. It was brought before the Council in consequence of the very large number of complaints as to the insufficient lighting of the Embankment. The assumption was that the Embankment was not sufficiently lighted, and the result was that the Highways Committee brought up a recommendation to light it with electricity, the cost of the installation to be £10,000. Then the Council went further, and said that the Waterloo and Westminster bridges, and the gardens, should be included, and the Highways Committee subsequently brought up an amended estimate of £15,000. Then the Council said: "Where will you put up your standards?" The Highways Committee were in favour of placing the standards down the centre of the Embankment; but the Council would not have that, and they had to go back and increase their estimate from £15,000 to £20,000. The Council already had power to spend £15,000. As Col. Ford had pointed out, they had power to carry out the work. That question had been raised, and to remove any doubt, they went to Parliament, and they had the power to carry out the work. The engineer told them it would cost some £1,300 to place the incandescent light on the Embankment, for they would require new burners and new standards. One of the great drawbacks they were told also, was that the incandescent light cast great shadows over the road, and that would be very undesirable. He would also like to say that the incandescent light had been tried, and he believed had just been given up at the St. Martin's Hall, because it was found to suffer from the vibration. He had no doubt the committee would be able to give little, if any more, information; but if they wanted to send it back and delay the matter, let them at once discharge the order, and have done with it.

Mr. Westacott inquired what had been done with respect to thinning the trees on the Embankment, as the report stated the light would necessarily be to some extent obscured by the trees at the side of the footway.

Mr. Hubbard replied that they understood it was the intention of the Parks Committee to take away every alternate tree along the Embankment.

The amendment was put and carried.

The Chairman said it would be better now to take the amendment as the motion, and to move the remaining amendments of which notice had been given as additions to the motion.

Mr. E. White said that in accordance with that suggestion he would move: "That the committee be asked to report what is the cost of the present lighting, what would be the cost of incandescent gas lighting, and what would be the cost of electricity supplied by a company." He was not opposed to the Embankment being lighted by electricity, for of all places he thought it was the most suitable to be so lighted. What he was struck by, however, was the enormous cost at which it was proposed to instal the light. He found the capital expenditure to instal that light was £16,590, which divided amongst 83 lamps came to exactly £200 each. It did appear to him that £200 capital expenditure was an enormous sum, and he was told by those well able to judge that that installation could be economically carried out at £10,000 rather than £16,000. Then again, the annual cost was set down there at nearly £3,000 per annum. It was £2,768, which amounted to £33 per lamp. Well, one of their large towns, Portsmouth, had during the last few years maintained their lamps at an annual cost of £18, and he did not know why it should cost £33 to light those 83 lamps. Again, the amount charged for wages seemed very high, it being something like £9 per annum for each lamp. He thought they should know what the electric light companies in the immediate neighbourhood would charge to supply the current to those lamps. He had no doubt the committee had made itself acquainted with the cost of the companies, but he did think the Council should know, before embarking upon that thing, what it would cost. Of course, it was well known that the smaller the number of units they had to consume, the larger in proportion was the cost, for a small installation cost a great deal of money, and a large sum per annum to keep it up. Then, again, he found the station proposed to be erected was to be on the vacant piece of land below Charing Cross Bridge.

Mr. Jones: That is not so.

Mr. White said he was given to understand it was, but as there seemed to be uncertainty, that was another reason why the report should be referred back, to know whether they should disfigure the Embankment. His amendment was not a hostile one to the committee, for he was quite in favour of electric lighting, but he wanted to know if it could not be carried out more to the advantage of the ratepayers.

Major Probyn said he would second the amendment, because he was convinced the lighting of the Embankment would be a good thing; especially the better lighting of the river for navigation. He would have liked to have seen the recommendation divided into two parts, and separate estimates brought up for the bridges and the Embankment. He thought it was also essential that they should indicate where the station should be placed. He thought it most important that they should get the charge from the various electric companies in the district. There were two having powers there—the Strand Electric Supply Corporation, and the Metropolitan Electric Supply Company. Until they got prices from them, and the committee submitted them to the Council, he felt it was absurd to make a pretence of giving an expression of opinion. He might also remind the committee that the Corporation of the City of London and the Metropolitan Board of Works lighted the Embankment by electricity, and the standards they used were still in existence, and if they could use them, it would reduce the cost very materially.

Sir Joseph Dimsdale, while supporting the amendment, did not feel altogether in favour of the electric light, because when it was tried before it was found it did not pierce the fog like gas. It might be that the strides electricity had made of late years had remedied that defect, but still it was a most important matter to be considered in connection with the Thames Embankment.

Mr. Hoare observed that another reason for sending the report back was, that lately they had fixed on a period for the repayment of electric lighting loans, and it would be most inconvenient should they depart from the fixed rule.

Mr. Jones said it was a mistake to suppose the station would be erected under the arch. It would be erected on a piece of ground on the east side of the Metropolitan Railway. As to the question of cost, they had the figures of one company, and the cost of that company was sent in at £30 per lamp, which amounted to £2,490 per annum; while the Council had to provide the columns, lamps, and wire, the difference between the company's estimate and the Council's estimate being £217; so, if they reckoned the cost of lamps, wires, &c., he thought the cost would be about equal. The estimate of the company, also, was for 136 lamps, and possibly they might require a higher price for a smaller number of lamps, and, also, they provided for 260 hours less light than the Council's engineer; and, taking all those things into consideration, he thought the estimate of the engineer was lower than that of the outside company.

Mr. Beresford Hope urged that it would cost little more trouble to get estimates from all the companies, as the report was already referred back.

Mr. Westacott said that although one company had offered to supply the light, no application was made to the others. Major Probyn gave his reason for wishing electric light, that it would light up the river, but, as a matter of fact, it was proposed to leave gas on the parapet.

Major Probyn: That is why I want it referred back.

Mr. Westacott said that was a fresh instruction, and if the estimated cost was more they must not complain.

Mr. J. Burns said he was strongly opposed to the work being given to private companies. There were two companies having powers over the district, and one company could not do it alone, and they would not combine. If they had their own private installation, they could do it cheaper than either of the two companies.

Mr. Hubbard said that the Council had already ordered the report to go back, but for the honour of the committee he wished it to be known that they had discussed the question, and they must not think they went blindly into the recommendation. They thought it would be an advantage to the ratepayers to supply the light themselves. There were two or three companies having the power, and one company wrote offering to supply it for £2,490, but that would not include lamps and wiring, &c. Their own engineer's estimate was £3,000, but they must remember the sum of £672, repayment of loan and interest, would be coming back to the ratepayers, instead of into the pockets of the company.

The motion was then put and carried.

It was further agreed, on the motion of Mr. Benn, that the committee should bring up a report as to the cost of including in the estimate the lighting of the Victoria Embankment Gardens.

LEGAL.

The Prescot Electric Light Contract.

Mr. Justice Grantham and Mr. Justice Wright, sitting as a Divisional Court in the Queen's Bench Divison, on Monday last, had before them the matter of the British Insulated Wire Company *v.* the Prescot Urban District Council. Mr. Sanderson said that

in this case he had to ask that the special case should be marked urgent, and be put in the list of hearing on Monday next. The plaintiffs had supplied the defendants with electricity and plant, for which a certain amount had been paid but the defendants had got three quarters in arrears in their payments. The question to be decided was whether an agreement made between the parties was invalid by reason of a certain section of the Public Health Act. The case, which was to have been tried at the Liverpool Assizes had been converted into a special case for the opinion of the Divisonal Court.

Mr. Danckwerts, who appeared for the other side, supported the application. He stated that the short question to be decided was whether by reason of it not having been stated what was the penalty for non-performance the contract was void. Unless the dispute was decided before the Long Vacation the Local Authorities would be unable to enter into another contract for the lighting of Prescot during the winter.

Mr. Justice Grantham said that the case should be in the paper for Monday next.

Barclay *v.* New Zealand Electrical Syndicate, Limited.

In the Chancery Division of the High Court of Justice, on Saturday, the 20th inst., Mr. Justice North had before him a motion for judgment in a debenture-holder's action which came on by consent. So far as was known there had only been one issue of debentures, which was for £30,000, and the plaintiff held the whole of the issue. The company was formed to light the city of Wellington in New Zealand with electricity. The action was commenced last March on the ground of jeopardy.

Mr Justice North made an order that the plaintiff was entitled to a charge, continued the receiver and manager, and directed the usual accounts and inquiries.

Scarlett *v.* Frank & Co., Limited.

In the Chancery Division of the High Court of Justice, on Friday the 18th inst., before Mr. Justice North, this was a motion for the appointment of a receiver and manager. The defendant company was incorporated in 1893 to carry on the business of electrical engineers and builders. Mortgage debentures to the extent of £600 were issued, of which the plaintiff was the main holder. These had become payable and had not been paid, and it was stated that the company was in difficulties and that an execution had been put in. The company did not appear.

Mr. Justice North made the usual order for a receiver, with a reference to chambers.

New British Electrical Installation Contractors, Limited.

Mr. Justice Kekewich, sitting in the Chancery Division of the High Court of Justice on Thursday last week, had before him an application by counsel on behalf of a gentleman named Martin, the nature of whose claim did not transpire, for the appointment of a receiver and manager of the New British Electrical Installation Contractors, Limited. Counsel said the matter was urgent, and Mr. Fawcus appearing for the company and consenting, Mr. Lester, of Worcester, was appointed as asked for, but his Lordship expressly refused to give any directions as to management.

Wood *v.* Woodhouse & Rawson United, Limited.

A summons in this action was set down in Mr. Justice Vaughan Williams list of causes for hearing on Wednesday in the Chancery Division. At four o'clock, when his Lordship was about to adjourn for the day, counsel engaged made an application that as the Court had been unable to reach the case that day, his Lordship might fix an early day for hearing it. The question was one as to whether proceedings should be taken against the directors or not. His Lordship had directed the company to hold a meeting to consider what should be done. The meeting had been held, and it was desirable that the matter should now be disposed of as soon as possible.

His Lordship said that if there was a vacant day they might have it. He could not say whether there was or not, but they could apply to the Registrar.

Clements *v.* Edwards.

Mr. Justice Wright, sitting in the Queen's Bench Division on Saturday last, heard, without a jury, the short action of Clements *v.* Edwards, to recover £71 13s. 9d. balance of account for 700 gross of electrical light fittings supplied by a Birmingham firm at 7s. 6d. a gross to defendant, who appeared in Court. He challenged the claim only on the ground that he had been sued before the expiry of his credit for the goods, and that the agreed-upon discount had not been allowed him. In the result his Lordship found for the plaintiff for £45 15s. 9d.

ALUMINIUM THE SUPERABUNDANT METAL.

Dr. Wintz in the *Engineering Magazine*, did good service not long ago in putting before us the condition and prospects of the aluminium industry to-day. Representing fully 8 per cent. of the known solid crust of the earth, coming next after oxygen and silicon in abundance, aluminium is still scarce and dear, simply because when once combined with oxygen it is difficult to free it. Though dry clay contains 24½ per cent. of aluminium, the favourite source of the metal at present is bauxite, which contains 28 to 31½ per cent. of aluminium. Though Davy tried to obtain the metal, which he reasoned was the base of alumina, it was not till 1826 that Oersted attempted the same by means of mercury, and failed, to be followed successfully in 1828 by Wöhler, who used potassium, while electrolytic aluminium is to be shared as a discovery between Deville and Bunsen in 1854. Castner in 1886 brought out the sodium process, which the Aluminium Company are still employing, though they now stop when the sodium stage is reached, and finally the Cowles process for aluminium alloys, and the French (Heroult) and American (Hall) processes for rich metal hold the field to-day. Commercial aluminium which contains less than 2 per cent. of silicon and iron has the following properties: Colour, a silver white (or rather a tin white), Sp. G. 2·56 for ingots to 2·61 for wrought, and 2·67 to 2·8075 for foil. Weight per cubic foot, 163 pounds. In malleability almost equal to gold or silver. Specific heat, double that of iron. The price in America is 35 pence per pound; in Europe 25 pence, a fact that tells us that the price of such utensils as are now made from aluminium is largely a fancy price. Copper articles, such as tubes, can be bought for 7½ pence per pound. Aluminium is thus about four times the price of copper. The specific gravity of copper is 8·92; for tubes, therefore, of equal thickness, aluminium is practically identical with copper, and it can be stamped, drawn, forged, pressed, and spun into all shapes, and should, therefore, come into extensive use as soon as a reasonable price is asked for it. Weight for weight copper has an electrical conductivity but 57 per cent. of aluminium, though about double per cross sectional area. The heat conductivity is of about the same ratio also. Alkalies attack it, but it is not readily oxidised, and an ash tray in the present writer's room exposed to the fumes of London gas has remained clean and bright for a year.

Resisting sulphur compounds, saliva, and organic liquids, it is eminently suitable for culinary and dental purposes. Its melting point is uncertain, but between zinc and silver. It must be melted in plumbago crucibles, as it takes up silicon from clay pots. A charcoal covering is sufficient, and no fluxes are to be used. Its latent heat of fusion is probably high, but as yet undetermined.

In the Cowles process only alloys, mainly with copper, can be produced, this electrolytic process being an adaptation of the British patent of January 31st, 1862 (Moncton's). An arc between very large carbon electrodes is diffused through the ore mixed with granulated copper and carbon. The alumina melts, the carbon deoxidises it, and the aluminium vaporises and is absorbed by the copper.

In the Hall process carried on at Niagara the process is the electrolysis of fused cryolite saturated with pure alumina. Each bath yields one pound of metal per hour for a consumption of 18·1 electrical horse-power.

The Heroult process is similar, but without the solvent.

Aluminium can be annealed at red heat by slow cooling. It can be best worked at 400° to 600° F., can be cast $\frac{1}{16}$th inch thick, and the castings will bend nearly double.

It can now be soldered and can be electrically welded. The aluminium bronzes contain from 2½ to 9½ per cent. of the metal, and resemble gold in colour, but they are of considerable specific gravity, nearly that of copper. Their strength is that of steel. Thus Cowles A1 bronze has averaged 111,280 pounds in tension per square inch. The bronzes can be forged like iron at a red heat, and are softened by chilling. They resemble copper in electrical conductivity.

Aluminium softens and toughens iron castings, and prevents blowholes. It is the basis of the "Mitis" castings.

The author looks to a price of fivepence per pound in the near future and a yearly production equal to that of copper.

For people who like the colour we see no reason why aluminium in its pure form should not take the place of every form of crockery in domestic use. Its lightness and unbreakableness render it specially suitable. No longer will tabby be called upon to keep the potteries employed. Her spare hours, when not at the whisky bottle, may be spent in solos to the moon.

The French manufacturers at Froges promise that when the sales reach 3,000 tons annually they can put the price at 7½d. per pound. Probably it is to the universal recognition of the fact that aluminium articles are now so much dearer than even the 25d. per pound justifies, that sales do not increase even more rapidly, for the people who would be large users simply hold back from purchasing in expectation of an early reduction. As an example of prices the ash-tray we have named above weighs less than ¾ ounce, but was sold in a Wolverhampton shop for one shilling, or at the rate of about 25s. a pound. It is simply die pressed from thin sheet, and probably was thus pressed for less than sixpence per 100. The ingot value of the material is thus about one penny.

BUSINESS NOTICES, &c.

Agency.—Messrs. Francis & Spilsbury, of 20, Bucklersbury, E.C., have been appointed agents for the sale of Messrs. Connolly Bros. manufactures in the East, South, and West of England (not including London).

Annual Outings.—The annual outing of the employees of Callender's Bitumen, Telegraph and Waterproof Company, Limited (Midland Branch), was held on Saturday last. The party drove over to Kenilworth.

The employees of the Aberdeen Corporation Electrical Department went for their annual outing to Waterton of Echt on 17th inst.

Bankruptcy Proceedings.—A general meeting of the creditors of Joseph Torr Todman was held last Monday at the London Bankruptcy Court to consider a proposal that has been lodged by the debtor. The chairman reported that the debtor offered to pay a composition of 7s. 6d. in the £ by instalments extending over eight months. The accounts showed liabilities £775 3s. 10d. and assets £87 7s. 2d., after payment of preferential debts, so that subject to the security offered being fully approved, the terms of the proposal appeared to present an advantage over the administration of the estate in bankruptcy. A vote was taken at the meeting, and the chairman declared that out of a total of £1,029 that had been proved, creditors for £811 had entertained the scheme, which was accordingly carried by the statutory majority. The debtor attended before Mr. Registrar Linklater the following day for public examination, and the examination was concluded the same day.

Business Announcements.—The Nalder & Harrison Construction Syndicate, Limited, inform us that they have purchased the stock, plant and goodwill of the engineering business carried on by Messrs. John Brown & Co., at the Perseverance Works, Bow, E.

Mr. R. Booth, of 110, Cannon Street, E.C., has taken into partnership Mr. H. W. Ravenshaw, A.M.I.C.E., who for the past 11 years has been chief of the electrical staff of the firm of Messrs. W. T. Goolden & Co. They will carry on the business of consulting, mechanical, and electrical engineers, under the style of Booth and Ravenshaw at the same address.

Carbons.—We are informed that Messrs. Krupka and Jacoby are supplying large quantities of Dr. Lessing's carbons, both rods and plates, to the English Market.

Cigar Lighter.—The Edison & Swan United Electric Light Company, Limited, have among their specialities the Ediswan new cigar and pipe lighter which is for use with alternating currents only. This apparatus consists of a small transformer which reduces the E.M.F. of the primary alternating current from 100 volts to two or three. It is specially adapted for use on shipboard and is recommended for use in hotels, restaurants, &c. We have received a list giving an illustration of the apparatus.

Dissolution of Partnership.—We understand that Messrs. R. P. Gerland and F. Tomlinson (carrying on business as electrical engineers and electroplaters at Accrington under the style or firm of Gerland, Tomlinson & Co.) have dissolved partnership as and from April 3rd, 1895. All debts due to and owing by the late firm will be received and paid by R. P. Gerland.

Price Lists.—From Mr. James Pitkin, of Clerkenwell, we have received illustrated price lists of the Holden hot wire recording voltmeter and ammeter.

From Messrs. J. Stenson, Haswell & Co., of Leicester, we have received a copy of List D dealing with continuous current dynamos.

The General Electric Company.—The staff of this company held, last Saturday, their annual festival, athletic and otherwise, at the Angler's Rest, Bell Weir, Egham. The party proceeded by train to Shepperton, and thence by launches to Egham, where dinner was served. In the morning and again in the evening the rain did its best to mar the entertainment, rude Boreas filling up the interval, but nothing could effectually damp the ardour and enthusiasm of the G.E.C. members and staff, and a most enjoyable day was spent by all. Mrs. Hirst graciously distributed the various prizes to successful competitors in the sports, and the company then returned to Shepperton by commodious steam launches, whence the train conveyed the staff and guests back to Waterloo.

To Contractors.—The offices of the Controller of Stores (Postal Telegraphs), hitherto situated in Telegraph Street, have been removed to the General Post Office, St. Martin's-le-Grand.

Velvo-Carbon.—From the Battery and Motor Company, Limited, we have received a number of sheets descriptive of Mr. H. T. Barnett's patents. The various uses to which velvo-carbon may be applied are stated, and following are illustrations, prices, and general particlars of velvo-carbon rods. Traction batteries (natural depolarisation) are dealt with, the advantages which are claimed for launches fitted with the Velvo-carbon batteries as compared with storage launches being noted. There are also erecting and working instructions for traction batteries. Further sheets deal with temporary lighting batteries (natural depolarisation), electric light and power batteries (natural depolarisation), details, prices, erecting and working instructions; plunge batteries, series batteries, single cells, "Granule" batteries, zinc plates, acid tanks, and a variety of accessories. A photograph of the electric launch, *Velvoca*, appears on the front page. The paper, printing, and general get up are excellent, and we have pleasure in recommending this set of sheets, which are handily fastened in cardboard covers, to the attention of our readers.

ELECTRIC LIGHTING NOTES.

Aberystwyth.—A local paper says that the Public Lights Committee recently recommended the erection of two additional lamps and lamp standards, which the Bourne & Grant Electricity Supply Company said they could have fixed in about a month. The Council has referred the matter back with a view to some rearrangement of the existing lamps being effected if possible.

Bath.—Some extensions which are being carried out at the stay works of Messrs. Bayer & Co. will be lighted throughout by about 300 16-C.P. lamps. Arc lamps will be used in the warehouses and more lofty parts of the premises. A Griffin gas engine of 50 I.H.P. is to be erected for driving the electric light machinery Messrs. S. Griffin & Co., of Kingston Iron Works, are to supply the engine power; Mr. Alex McTavish, of Green Street, will undertake the electrical work, having successfully carried out the complete installation for Messrs. Bayer's new factory at Oldham Common.

Belfast.—At the last meeting of the Electric Committee, Prof. Kennedy's report on the working of the engines and plant, which was of a satisfactory nature, was read, and payments were ordered to be made.

Dover.—The Electric Light Company have given notice of their intention to put in mains on the Maison Dieu Road, &c.

Edinburgh.—A committee has resolved to recommend that George Street, and the various side streets therefrom to Prince's Street, be lighted by electricity.

Glasgow Tunnel Lighting.—The harbour tunnels at Glasgow, which were recently opened to both passenger and vehicular traffic, are lighted by electricity. At the generating station there are three sets of direct coupled plant, also the hydraulic machinery necessary for working the pumping plant and lifts. The electrical equipment comprises three sets of Phœnix dynamos, directly connected to Belliss engines. Two of the generators each give 186 ampères, and the other 55 ampères, both at 110 volts. There are 22 arc lamps and 110 incandescent lamps of 32 C.P., and covered mains, insulated by a preparation of resin oil run in iron pipes, are laid. This arrangement has been adopted for the purpose of preventing any moisture obtaining access to the mains carried down the shafts and along the tunnels, of which there are three.

Halifax.—There was a Local Government Board inquiry here on 19th inst. regarding the Council's application for power to borrow an additional £10,000, for electric lighting purposes.

Hampstead.—Mains are to be laid in the following roads for private lighting:—Alexandra Road, at an estimated cost of £842; Avenue Road, £755; Belsize Park Gardens (remainder), £201; Fairfax Road, £275; Finchley Road (Langland Gardens to West End Lane), £217; Hampstead Hill Gardens, £170; Heath Street (remainder), and North End, £571; and Kidderpore Avenue, £151.

Harrogate.—We learn that Mr. Geo. Wilkinson, M.I.E.E., has been appointed to advise on the lighting of the new Montpellier Baths, which are being erected by the Corporation of Harrogate at a cost of £75,000. The supply will be taken from the town electricity works, which Mr. Wilkinson also has in hand for the Corporation.

Ipswich.—A representative of the County of London and Brush Provincial Electric Lighting Company, Limited, notified to a Committee of the Council the intention of his company to apply for a provisional order for lighting Ipswich electrically. The matter is to come before the Council.

Islington.—The Vestry is to invite H.R.H. the Prince of Wales to open the central electric lighting station in November. The chairman of the Electric Lighting Committee laid the last stone on the summit of the chimney stack at the station the other day.

Liverpool.—For the information of the members of the Lighting Committee, a report is to be drawn up showing what has been done in the negotiations between the Electric Supply Company and the Corporation.

London.—The Shahzada gave a grand reception on 18th inst., at Dorchester House, and the grounds adjoining the house were lighted with electricity.

A Committee of the Metropolitan Asylums Board has instructed Prof. A. B. W. Kennedy to draw up a scheme and specification for the electric lighting of Brook Ambulance Station from the installation at Brook Hospital.

Manchester.—A communication in a local paper from a firm which has abandoned gas in favour of electricity, complains about the high charges for electricity as compared with gas. Taking the two last quarters in 1894 and the two first in 1895, when the electric light was used, and comparing them with the corresponding four quarters of 1892 and 1893, the cost works out: gas, £45 16s. 9d.; electric light, £118 7s. 11d. The correspondent does not state the C.P. of light now used.

Rotherhithe.—The Vestry has decided not to oppose the application of the Capital and Counties Electricity Supply Company for a provisional order.

Russia.—It is reported that a contract has been entrusted to Messrs. Schuckert & Co., of Nuremburg, for the carrying out of an electric lighting installation in the Palace at the Kremlin in Moscow. The installation will comprise 15,000 4-C.P. candle-shaped lamps, 2,000 16-C.P. incandescent lamps, and 40 arc lamps.

Worcester.—At a recent meeting of the Town Council, a speaker, alluding to the electric lighting scheme, said that the profit made up till the end of March was £1 13s. 2d., leaving capital and interest unprovided for, which must be a loss and burden on the ratepayers.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Australian Mines.—We cull the following from the *Sydney Bulletin* for June 1st:—"N. S. W. Hillgrove and Armidale Water-Power Electric Company is worried. After laying down an expensive plant worth at least £25,000, and making agreements with the mining companies, it is unable to supply the mines with power, owing to the water at Hillgrove having given out. The past season has been the driest known in New England for the past 20 years."

Dublin Electric Tramways.—At the ordinary meeting of the Dublin United Tramways Company on 16th inst., the chairman dwelt at length upon the company's Parliamentary Bill in regard to the Clontarf line of electric tramways, and the manner in which they had been treated by the Dublin Corporation and other local bodies. He also said that if the company was so minded, it might yet have the electrical traction on the Clontarf line extended to Nelson's Pillar; the board is quite prepared to insert clauses for the protection as regards this line. A very strong point in favour of this particular line is that the frontagers along the streets at both sides, and for its entire length, have signed a memorial in its favour with practical unanimity, 370 out of a possible 385 having given their signatures.

Electricity on Steam Roads.—A trans-Atlantic exchange, in a recent note, remarks that the substitution of electric motors for locomotives on steam lines seems to be proving eminently satisfactory thus far. The reports of the test on the Nantasket Beach electric line of the New York, New Haven, and Hartford Railway, which we described last week, while not yet very complete, seem to justify the enthusiasm of those engaged in the installation. The recent test on the Mt. Holly branch of the Pennsylvania Railway was fully as satisfactory. In both cases high speeds, reaching over 35 miles an hour, have been attained, and the economy in operation, it is said, leaves little to be desired. Both roads are likely to demonstrate some of the possibilities of the overhead system as well as the value of good construction, for no expense has been spared to make the installation as perfect as possible.

A very successful experiment was made on June 27th with the electric locomotive which will pull the Baltimore and Ohio trains through the Belt Line tunnel. Four trips were made without delay. No effort at speeding was attempted, but it is thought the engine can easily run 50 miles an hour. The contract calls for at least 30 miles. The new motor has doubtless been put into regular service ere this.

South Staffordshire Tramway.—The generating station of this tramway was visited on 22nd inst. by a party of members of the South Staffordshire and East Worcestershire Institute of Mining Engineers.

TELEGRAPH AND TELEPHONE NOTES.

A Prospective Cable Station.—From a telegram received from Brazil, we learn that much excitement has been caused in Rio de Janeiro, and that the Radicals are clamouring for vigorous measures, owing to the fact that a report has been received of the British occupation of the Island of Trinidad. This small island, which is about six miles in circumference, and lies some 600 miles eastward from the Brazilian Coast, in about latitude 20° S., is reported to be uninhabited. It was visited and taken over by one of Her Majesty's ships about six months ago. The island is, we believe, claimed by Brazil, but it appears that in April, 1700, Captain Edmund Halley landed here, and, in his journal, he says:—"I took possession of the island in His Majesty's name, as knowing it to be granted by the King's Letter Patent, leaving the Union flag flying." It appears that the object in reasserting the claim of England to this island is to retain it as a convenient landing place in a system of strategical cables, which for some considerable time has been contemplated by the English Government. An interesting account of this island will be found in "The Cruise of the *Alerte*," which gives a description of the voyage to Trinidad in search of buried treasure. This book is written by the author of "Where three Empires meet," which has recently attracted so much attention.

Cable Repair.—We learn that the Alboran cable which connects Almeira, in Spain, with Melilla, was repaired about the middle of this month by Mr. Primitive Vigil, one of the principal members of the Spanish Telegraph Department. It appears that the fault was in the shore end, which seems to have been laid right across the anchorage.

Dover Telephones.—The telephone service at Dover, as well as London and other places, has been temporarily disturbed lately. The fact is, the whole of the local wires—which have never been very satisfactory since they were put in by the old South of England Telephone Company—have and are being reconstructed under the direction of Mr. Owen, the district manager.

Scotch Telegraphs.—Telegraph facilities are to be provided immediately from Gairloch to Badachro, and other parts of Ross-shire.

New Telegraph Line to the River Amazon.—According to the *Engineer*, the Peruvian railway system will shortly be extended inland a distance of 264 miles, so as to reach the navigable waters of the Amazon. A railway naturally means a telegraph line.

The Pacific Cable Scheme.—The *Times* of last Saturday published the lengthy correspondence which has taken place between Lord Ripon and the Governors of the various colonies represented at the Ottawa conference, with reference to trade relations. No mention whatever is made of the proposed Pacific cable.

CONTRACTS OPEN AND CLOSED.

OPEN.

Bradford.—July 30th. Tenders are wanted for electrically lighting the mechanics' hall and saloon of the Bradford Mechanics' Institute. Particulars of Mr. T. C. Hope, architect, 27, Kirkgate, up to 30th inst.

Cowes.—August 27th. Tenders are invited for laying down electric lighting plant of sufficient capacity to supply at the same time 2,200 8-C.P. lamps, also public lighting and the laying of mains to accommodate 3,000 lamps. Details can be obtained from Mr. N. F. Dennis, engineer to the Council, Cowes.

France.—July 30th. Tenders are invited for the supply and laying of a submarine telegraph cable between Ovock and Djibonti. Tenders to the Direction Generale des Postes et des Telegraphs, 103, Rue de Grenelle, Paris.

France.—August 1st. Tenders are being invited for the supply of a quantity of paper insulated electric cables, in five lots. Tenders to be addressed to the Direction Générale des Postes et des Telegraphes, 103, Rue de Grenelle, Paris.

France.—August 1st. Tenders are being invited for the supply of 50 kilometres of telephone cable (double conductor) in one lot. Tenders to the Direction Générale des Postes et des Telegraphes, 103, Rue de Grenelle, Paris.

France.—August 11th. The Municipal Authorities of Ille-sur-Tet (Pyrénees Orientales) are inviting tenders for the concession for the electric lighting of the town. Tenders should be directed to the Mairie d'Ille-sur-Tet (Pyrénees Orientales), France.

Holland.—August 9th.—The Minister of the Waterstaat at the Hague, is inviting tenders for the construction of a new post and telegraph office in Amsterdam. Tenders to above.

Malta.—August 1st. The Crown Agents for the Colonies and the Receiver-General and Director of Contracts at Valletta, Malta, are inviting tenders for the supply of materials in connection with the installation of the electric light in the civil and war department buildings in Malta.

Rangoon.—November 4th. The Municipal Committee is inviting tenders for electric lighting. Particulars to be obtained from Messrs. Ogilvy, Gillanders & Co., 67, Cornhill, E.C.

Roumania.—July 29th. The Municipal Authorities of Braila, Roumania, are inviting tenders for the concession for the construction and operation of an electric tramway along the main streets of the town.

Salford.—July 31st. Tenders are invited by the School Board for the installation of the electric light into their new offices, Chapel Street, Salford. Plans and specifications, with forms of tender, may be obtained from Mr. S. V. Clirehugh, A.M.I.C.E., Temple Chambers, Brazennose Street, Manchester.

Spain.—The Municipal Authorities of Biar (Alicanté province) are at present inviting tenders for the concession for the electric lighting of the town during a period of five years. Tenders to the Secretaria del Ayuntamiento, Biar (Alicanté).

Spain.—July 28th. Tenders are being invited by the municipal authorities of Deva, a small seaport town in Guipuzcoa province, for the electric lighting of the public streets under a ten years' concession. Tenders to be sent to El Secretario, del Ayuntamiento de Deva (Guipuzcoa).

Surbiton.—Six firms are to be invited to send in plans and specifications for electric lighting.

Wakefield.—The Corporation Electric Lighting Committee invites tenders for the supply and erection of boilers, engines, alternators, switchboards, cables, transformers, arc lamps, &c., &c., for the intended electric lighting installation. For further particulars, see our advertisement pages.

Wellington (Salop).—The Shropshire Iron Company are inviting tenders for electric lighting plant, forges, &c., &c.

CLOSED.

Bedford.—The local authority has accepted the following tenders in connection with the electric lighting work:—

Babcock & Wilcox, two boilers	£960	0	0
W. H. Allen, Sons & Co., two engines	906	0	0
Siemens Bros. & Co., two alternators	1,530	0	0
Doulton & Co., one mile of stoneware culverts	137	10	0
Telegraph Manufacturing Co., Ltd., cables, 1s 7d., 6s. 2½d., and 9s. 2d. per yard respectively.			
Johnson & Phillips, three transformers ...	225	0	0

Brighton.—In response to the invitation of the council for tenders for the supply and erection of steam and feed piping, feed pumps, economiser, water purifier, tanks, coal elevator, and sundries required at the electricity generating station, only one tender was received, viz., from Messrs. John Fraser & Son, of Millwall Boiler Works, who offered to do the work for the sum of £3,220. This tender has, therefore, been accepted. The Lighting Committee are not at present prepared to recommend the acceptance of a tender for the supply of the condensers, air pumps, air pipes, &c. There was so much detail that they had not been able to get the matter ready.

London, N.W.—For the electric lighting of the new wards and other buildings now in course of erection at the North Western Fever Hospital of the Metropolitan Asylums Board, at Haverstock Hill, the following tenders were sent in according to a plan and specification which was prepared by Prof. W. E. Ayrton. The lowest tender was accepted:—

Thorpe & Waring (accepted)	£554	0	0
Electrical and General Engineering Company, 86, Leadenhall Street	649	0	0
T. Matthews, Islington	650	0	0
Waring & Sons, 181, Oxford Street	688	15	0
Fowler, Lancaster & Co., Birmingham ...	859	15	0
Benham & Sons, Wigmore Street	870	0	0
Paterson & Cooper, Victoria Street	895	0	0
J. Sax & Co., Ridgmount Street	944	8	9
J. C. Howell, Limited, Queen Victoria Street...	981	16	4
London and Lancashire Electrical and General Engineering Company	1,050	0	0
Miller & Woods, Gray's Inn Road	1,070	0	0
Sharp & Kent, Victoria Street	1,098	0	0
Tayler-Smith Electric Company, South Moulton Street	1,124	0	0
Roger Dawson, Limited, Berners Street ...	1,140	0	0
H. Tyler & Co., Whitecross Street	1,340	0	0
V. G. Middleton, Westminster	1,440	0	0
Vaughan & Brown, Kirby Street	1,557	0	0

NOTES.

Critical Condition of Tesla.—Our readers will be grieved to learn, on the authority of Mrs. Bloomfield Moore, in the *New Science Review*, that Mr. Tesla is in a very awkward position. It is a number of days, says this gifted woman, since Tesla crossed the border line of the circle in which other electricians are working, but he still remains in the interatomic field of research, unmindful of the triple conditions that govern electricity in the relation which it sustains to the first order of the "luminous." This is sad enough, but we have yet to tell the worst. It appears that by reason of Tesla's wicked neglect of Keely's system of resonance he has missed the chance of hobnobbing with electrical phenomena in the sympathetic field, and is standing on a bridge which connects the primary two-thirds of the electric stream—the subdominant current with the dominant. What a fearsome post is his! But the consequences of his folly will still pursue him, and even though he may hook on to the dominant, he will still be subserved to the terrestrial neutral far in the rear of sympathetic union to radiating celestial outreach, the connecting link of which exists in the interluminous. Mrs. Moore says, further, that even in the event of Tesla's salvation, he will not have reached the compound interetheric. If such be the case, we should advise Mr. Tesla to climb down at once from his supradominant hypoluminous outreachment, and no longer seek to attain the interatomic realm, but to content himself with hard pan. The sting of Mrs. Moore is, however, in her—well, our readers will understand. Given a prompt cash settlement, and Keely will plank down all his secrets, and tell us how we may make a ten thousand ton ship float like a gossamer in the summer breeze. (Our readers will kindly take notice that this last poetic vein is our own, not Mrs. Moore's.) Failing this settlement they will die with Keely. The cosmical law of sympathetic association will then be lost to an ungrateful world, and Keely will rise on his vibratory mediums into the far outreach after a life spent in over-reaching, amongst others, Mrs. Moore.

Repairing Commutators with Litharge Paste.—A correspondent of our American namesake says that to repair either dynamo or motor commutators, where the mica is out, he has found the following plan excellent:—Take litharge and mix it to the consistency of thick cream with glycerine, then apply to the cracks, completely filling them; allow to dry for eight or 12 hours, then scrape off the top, or rather file it off smooth and level with the commutator.

Residual Charges of Condensers.—Some interesting experiments with reference to residual charges of condensers have recently been made by Mr. A. S. Dunstan, and are described in the *Electrical World*. The condenser experimented on was charged from water batteries, one set of condenser coatings being always connected to earth. A Thomson quadrant electrometer was connected through its reversing key to the two binding screws of the condenser. As usual, one set of electrometer quadrants was connected to the case, and the case to earth. The connections were so made that if the lever of the electrometer key was raised to its highest position, it would short circuit and thus discharge the condenser; if depressed as far as possible, it would connect the electrometer quadrants to the condenser coatings, and thus allow the electrometer to measure the potential difference between the condenser terminals. A key connected with the recording mechanism of a Duboscq chronograph was placed beside the electrometer key, so that both could be conveniently manipulated. The operation of taking one of the residual charge curves was as follows: The condenser was charged through a key for a certain number of seconds. At the end of this period, the key was thrown to the "insulate" position, and the electrometer key raised, thus insulating the condenser from the battery and discharging it at the same instant. After being discharged for a determined number of seconds, the electrometer key was depressed to its lowest position, and at the same instant the chronograph key was tapped, giving a zero record. As the residual charge gradually accumulated, the electrometer needle moved, indicating the rising potential, and the rest of the experiment consisted in recording upon the chronograph the readings. The condensers used were two as nearly alike as possible, made by the same maker, presumably about the same time, and of the same sort of materials. They were each of approximately one-third M.F. capacity, and their dielectric was mica. Throughout the work they were kept as near a constant temperature as possible. The first question studied was the effect produced upon the residual discharge by increasing the E.M.F. of the charging battery, and it was found that a residual charge produced by a charge of high E.M.F. will attain a given fraction of its maximum value in a shorter time than a residual charge produced by a low charging E.M.F., and, moreover, it was found that these maximum values are directly proportional to the number of cells in the charging battery; that is, the total residual charge is directly proportional to the E.M.F. of the charging source. This law was found to hold for glass by Hopkinson, but the proportionality is even closer in the case of mica. In the experimental results obtained by varying the time of charging, it was noticed that although the final charge may become as great as in the case where a higher charging E.M.F. is used, it is developed in a much more gradual manner, taking a longer time to reach its maximum. The final charge was not proportional to the time of charging, but, so far, Mr. Dunstan has been unable to connect them by any law. A very interesting and curious subject is that of the influence upon the residual charge of the previous treatment of the condenser. In the course of the work, the effect of a previous charge in the negative direction upon the residual charge produced by a charge in the positive direction was studied. That is, the condenser was charged for a determined number of seconds, in a certain direction called negative; it was then short circuited for a known time, then connected to the charging battery for a known length of time in a direction the reverse of the preceding, discharged, insulated, and the development of the residual charge taken also. The time of charging in the reverse direction was varied, the other quantities remaining the same, and the results thus obtained was compared with those produced when the condenser had had no previous negative charge. To obtain the results, the condenser was charged for a certain number of seconds, short circuited for 60 seconds, then charged for 10 seconds in the reverse direction, and finally short circuited for 10 seconds. It was noticed that as the time of charge in the negative direction increased, more and more effect was produced upon the residual charge. A peculiar phenomenon was observed. The condenser had previously been charged for 10 seconds in the negative direction, and one would expect that the effect of this would be to diminish the residual charge. It is found that although the total residual charge is diminished, yet the rate of develop-

ment is accelerated. This does not seem to be accidental, as it was found to hold for both condensers. It seems, then, that the *rate* of development of a residual charge is *accelerated* by the influence of a previous negative charge of short duration. It was found that if a condenser has been strained by a long-continued charge, or by one of high potential, weeks may pass before it becomes perfectly neutral again. In fact, one of the difficulties of the experiments was to get the condensers in a neutral condition.

The Cost of Niagara Power.—In *Cassier's Magazine* a Mr. F. L. Stetson discusses the cost of power from the utilisation of Niagara, and arrives at the extraordinary conclusion that in Buffalo, where coal is only $1.50 per ton, it would be cheaper for the good people of that city to employ the electrically transmitted power from the Falls, than to use coal even if it were furnished free at the furnace door. If his general deductions are made on such a basis as that which follows, we tremble for those who have invested money in the Niagara scheme. "When in England in 1890, I was told by an eminent gentleman that it was useless to discuss the profitable employment of water-power, for, as he said, 'You can produce steam-power from coal at a cost of a farthing an hour' (1 H.P. hour we presume, Eds. Elec. Rev.), to which I answered: 'Very well, let us work out the problem! Coal, at a farthing an hour, would, in America, represent 5 cents for a day of 10 hours, or 12 cents for a day of 24 hours, which is, for 300 days in the year, $15 for the short day, and $36 for the long day for fuel only. At Niagara we will gladly furnish continuous 24-hour water-power for $15 a year, in any considerable quantity.'" Of what avail is it to be able to furnish 1 horse-power per year for $15 at Niagara, if to get the same amount in Buffalo it is necessary to pay for more than double that power to make up for losses in transmission. More persuasive arguments than these are necessary, Mr. Stetson, to convince engineers of the economy of electrically transmitted power (even if the source is water) over coal at $1.50 per ton at the furnace door; and so far as the public is concerned, such writing is altogether misleading.

Death from Electric Shock.—It is curious to see how Dr. Bleile and Prof. Thomas fall into the trap, the fallacies of which, we imagined, were completely shown up during the Harness prosecution at Marlborough Street. On page 119 it is said that a lower voltage *with* lesser ampèrage applied for a longer time will have the same effect as a current of higher voltage *or* more ampèrage applied for a shorter time, because, says Prof. Thomas, the joules will be the same. Either the paper of Dr. Bleile has been incorrectly reported (the italics above, which are our own, seem to show that this may be the case), or the author is labouring under a misapprehension. Let us take one of his results—death of a dog from 52 volts and ·3 ampères after four seconds. Surely, if we take the same voltage and ·003 ampères for 400 seconds, death would not ensue, although the joules are the same in each case. It is evident, therefore, that low voltage and low ampèrage might be varied *ad infinitum* without causing death. It was said on behalf of the Harness belt that the mild continuous current of electricity generated by that apparatus when worn on the body, would effect the same result as a strong current applied for a few seconds; but, whereas the latter might have meant death to the recipient, the former only produced sores, although, after the lapse of a few years, the joules might have amounted to the same figure as in the case of the death shock.

For the Advancement of Science.—A recent number of *Science* recorded several generous gifts by American scientists, for aiding the advancement of scientific knowledge. One donor has offered £5,000 towards building a hall of science for the Syracuse University, if five promises of equal sums can be secured. The same university has also been offered £22,000 towards a new medical college. John Hopkins University has also been the recipient of a large sum for the purpose of establishing a geological lectureship.

Coal Calorimetry.—At the recent Detroit meeting of the American Society of Mechanical Engineers, a paper was contributed by R. C. Carpenter, in which he described a new coal calorimeter, which appears to determine the heating value of coals with much greater accuracy than the instruments most commonly employed. This calorimeter is the outcome of about three years continuous research in the laboratories of the Sibley College. It will probably commend itself to many on account of the fact that it can be handled without much previous training, and because, although it gives results accurate within 1 or 2 per cent., it does not consume much time either in preparation or in using. These advantages, we believe, are not possessed by any of the older instruments, for these require much skill and time in preparation for use, and necessitate a deal of complicated calculation in reducing the results. In construction the instrument consists of a combustion chamber having a removable bottom, and capable of being supplied with oxygen. The products of combustion are discharged through a spiral tube. Surrounding this combustion chamber is a larger closed chamber filled with water, and connecting with an open glass tube within which the zero level can be adjusted by means of a diaphragm and screw. There is a view-hole, through which the progress of the combustion can be ascertained. The whole is enclosed in a polished nickel-plated case, in order to reduce radiation. Needless to say, the heat is supplied by a thin platinum wire connected to an electric current. Those who are interested in the calorimetry of coal should certainly study Carpenter's paper. It will be found in the forthcoming volume (Vol. xvi.) of the *Transactions* of the American Society of Mechanical Engineers.

Standards of Light.—As long ago as December, 1891, the Board of Trade appointed a committee of eminent respectability, though doubtfully representative, to inquire into and report upon the question of the standards to be used for testing the illuminating power of coal gas. The committee have now reported. Truly, we cannot complain that they have arrived at their conclusions with undue haste; and it is not a little interesting that the outcome of their protracted deliberations is the recommendation of a standard which was proposed 11 years ago, and rejected for reasons, doubtless excellent in themselves, but chiefly known only to the "members of the inner ring," as certain lewd fellows of the baser sort have been wont to describe those who had the most weighty interests at stake. We have nothing to say here concerning the wisdom or unwisdom of adopting the pentane air flame furnished by the special argand burner which henceforward, till further orders, is to be the standard of light; it can hardly fail to be superior to the old sperm candle, and it at least has been developed scientifically. But the question arises in our minds whether the interests of the consumers of light would not have been better served if the committee which sat upon the standards had been leavened with a few representative electric light men. It is too late to urge such a point now, of course; but it is worth while bearing it in mind, in view of the by no means unlikely event of a new committee being formed some day to consider the amendment of the standard.

Croydon County Polytechnic.—The electrical engineering students at the Croydon County Polytechnic have been very successful at the May examinations of the City and Guilds of London Institute. In telegraphy, six students have taken first ordinary certificates. In electric lighting, three passed the preliminary, five passed first class, and two second class in the ordinary grade, and one took second class honours. One of the ordinary grade men, Mr. H. L. Mills, took the first place in the kingdom, the silver medal of the Institute, and the £2 attached to it. In each examination, telegraphy and electric lighting, there were two failures. Out of 35 students, 21 papers were sent in at the examination and 17 proved successful. The rapid progress made in the electrical department is principally due to the great interest taken in it by Mr. J. W. Steeps and Mr. T. Cushing, two well known members of the Technical Education Committee of the Croydon County Council. It has also been recognised that special lectures have done much to encourage the progressive spirit. Some extensions are proposed for the coming session.

The Working Surface of a Pulley.—A Canadian contemporary, in a recent note on this subject, says the question as to which side of a leather belt should run next to the shaft wheels is occasionally rehashed. In spite of all tests that have been made on leather belting, nothing has ever been said of the extra cling that the flesh gets by being easily squeezed into every depression on the face of the pulley, which the grain side has a tendency to bridge over. This seems to follow the law of friction where the particles of one material interlock themselves with those of another. Pulleys covered with leather, and wheels made of hardwood of all kinds, have given much greater driving power from the same grasp of belt than the handsomely polished metal pulleys have done, though this latter class of wheels has all the advantages that are to be derived from atmospherical influences. But the fine imperfections on the true surface, which are the real gear teeth of friction, are not there in the abundance found in the material that is more closely allied with the belting itself. Everything would seem to indicate that a driving wheel is finished in the wrong direction when a covering of leather adds so much to its driving capacity. The teeth of gear wheels are not cut lengthwise, and this gives all the hold that its strength will allow to the turn of a pulley, with the finishing cut taken crosswise and ground on a polishing wheel, herring-bone fashion. This may not be appreciated in the machine shop, but the object to be obtained is the very one that a draw file is used for, namely, to pitch the minute grooves found on every surface in the right direction.

Influence of Electrically Dissolved Gas on Deposited Silver.—The current number of *Wiedemann's Annalen* contains a paper by Herr J. E. Myers on the influence of gases dissolved in the electrolyte of a silver voltameter on the weight of deposited silver. The author finds, says *Nature*, as has previously been shown by Schuster and Crossley, that if the same current is sent through two voltameters containing neutral solutions of silver nitrate of the same strength and at the same temperature, one voltameter being in a vacuum, and the other in air, then the weight of the silver deposited in the vacuum voltameter is, for a solution containing from 20 to 40 per cent. of silver nitrate, about 0·1 per cent. greater than that of the silver deposited in the other voltameter. For a 5 per cent. solution the difference is somewhat smaller. If the solution is saturated with carbon dioxide, the deposit is about 0·055 per cent. lighter than when the solution is saturated with air. With nitrogen, however, the deposit is about 0·05 per cent. heavier than with air. The electrical resistance of a 5 per cent. solution saturated with air is practically the same as that of the same solution in a vacuum. With a current of more than 0·25 ampère, it is found that in vacuum an evolution of gas takes place at the anode. The author has also examined the grey deposit which is formed on the anode, and finds that it consists of pure silver oxide.

Analysis of the Tremont Turbine.—Prof. de Volson Wood contributes to the American Society of Mechanical Engineers an account of the test of the Tremont turbine, as made by Francis. It is interesting to note that these Tremont wheels were made with buckets of $\frac{9}{64}$-inch Russia iron, fitted between crowns of cast-iron in carefully cut grooves, and locksmithed into the crowns after the fashion so long followed by the English makers, Messrs. Gilkes & Co., of Kendal. The Tremont turbine is said to have given an 88 per cent. efficiency, and Prof. Wood analyses its proportions on the basis of his own notation and formulas with different coefficients of the friction of the water and guides, and finds a very fair agreement with the actual turbine.

Primary Battery Fallacies.—In the interests of primary battery inventors, whose name is legion, we have published, on page 98, Prof. Anthony's article on the Boynton multivolt battery, as it entirely endorses what we have already said concerning this absurd arrangement of galvanic elements. Prof. Anthony deserves the thanks of every electrician in the States for showing the true working of the Boynton cell.

Awards.—Among various awards which have been made by the Société d'Encouragement at Paris are prizes of 500 francs each to M. Lartigue and M. Roux for their investigations in connection with electrical installations.

Electric Lighting of Scattered Areas.—Like the majority of papers, the *Indian and Eastern Engineer*, of Calcutta and Bombay, seems to have completely misunderstood the Parfitt system of electric lighting, judging from a lengthy leading article in its issue of June 1st. The "last advices from home," if usually of the nature supplied by the representative of our contemporary, must give engineers in India and the East very wrong impressions of the technical abilities of their *confrères* who stay here. Says the editor:—"If this system were combined with the burning of refuse in destructors, as is being done at Ealing, near London, and as will soon be done in Shoreditch and St. Pancras in that town, we should, with the help of some additional power gained by water, wind, or fuel, not only get rid of a dangerous nuisance, but bring ourselves in line with many a small town in other countries." If engineering papers which are not electrical would, when occasion demands, secure the services of a competent electrician to inspect schemes of the Parfitt nature for them, we, too, should be rid of the nuisance of poring over the twaddle with which their non-technical representatives fill their columns.

Threat to Shoot a Corporation Electrical Engineer.—Mr. Wordingham, the electrical engineer of the Manchester Corporation, had occasion in the execution of his duties to discharge a fitter's labourer. The latter, who had his own ideas as to the sweetness of revenge, purchased a revolver, which aroused suspicions that his intentions were not of the kindliest. But this adventurous labourer was inexperienced in the manipulation of a shooting iron, and must needs practice with the weapon. We imagine his intense longings for revenge, and can almost see him setting up targets for the representation of Mr. Wordingham. It is very fortunate for that gentleman that the enraged workman needed practice, for had it been otherwise the matter might have gone farther and Mr. Wordingham fared worse. Happily, however, as the exercises progressed, the man was overheard breathing out threats of revenge. The next scene was in the City Police Court, when Lawson was bound over in two sureties of £20 to keep the peace for six months, or in default to practice in solitude for 14 days without the company of either a revolver or Mr. Wordingham.

Jonah and the Glow Lamps.—In a play entitled "Jonah," which has lately been acted at one of the New York Jewish theatres, Jonah is represented in one of the scenes with a number of electric glow lamps to lighten his darkness during his three days' sojourn in the sea-monster's interior. The *Electrical World* recently gave the following description of the scene:—"After Jonah has been thrown overboard, for a moment, it appears that nothing can save him. But, just as he is sinking for the last time, a great fish comes along, shaped something like a flounder, and deporting itself like a ball of rubber; it opens a very wide mouth and Jonah climbs in. Instantly the ship, which has been hammering the stage boards in its wild tossing, becomes still. The ballet sailors on the deck set up a jubilant chorus, and a gauze-dressed angel drops down from the flies, while the fish—which has disappeared behind the scenes—turns about and re-enters with a new side presented to the audience. This new side is as open as the day. Through an oval window in the whale's larboard quarter Jonah is disclosed sitting in great splendour of red and green, with glow lamps, and not a suggestion of discomfort."

Crompton's Alternating Current Work.—An error occurred in the text under one of the blocks illustrating the above article, which appeared in our last issue; instead of being Crompton-Brunton alternator with direct coupled exciter, it should have been described as a motor alternator, the illustration being from a set actually in use at the Sunderland Corporation Works, and having an output of 37½ kilowatts at 2,500 volts, the input to the motor being at 220 volts.

American Electro-Therapeutic Association. — We have been favoured with a copy of the constitution and by-laws of this association for the year 1895, together with a list of the fellows, officers, and committees. The fifth annual meeting is to be held at Toronto, Canada, on September 3rd, 4th, and 5th.

Conditions of Atmospheric Electricity.—Dr. J. Hann, in a recent paper, a copy of which he has sent to *Nature*, treats very thoroughly of the conditions of atmospheric electricity on the summit of the Sonnblick mountain, his deductions being obtained by aid of an improved registering hair hygrometer, by Richard. From observations at Alpine stations, he found that the yearly range of relative humidity on the mountain is the reverse of what it is over the plains; the minimum, or greatest dryness, occurs in winter, and the maximum in spring and summer. But at these stations the uncertainty of the behaviour of the hygrometers in low temperatures made the results doubtful. Temperature and vapour pressure on the Sonnblick run in nearly parallel curves, each degree of difference of temperature corresponds to a change of tension of vapour in the same direction. Dr. Hann deduces some interesting details regarding the daily range, for which we must refer our readers to the issue of *Nature* for July 18th, 1895.

Société Internationale des Electriciens.—From the Société Internationale des Electriciens we have received particulars of the new course for 1895-1896 Session, which will commence at the Central Electrical Laboratory at Paris on November 4th, 1895. Examinations for admission will be held in October. The programme for the session, which is to give to engineers that practical instruction necessary for employment in connection with the electrical industry, includes the following:—1. A course of 30 to 35 lessons on industrial electricity. 2. A course of 20 to 25 lessons on electrical measurement. 3. A series of conferences on special questions. 4. Some practical exercises in electricity. 5. Workshop practice. 6. The establishment of projects for industrial installations. 7. Some visits to works. Particulars to be obtained from le Directeur du Laboratoire, 12, Rue de Staël, Paris.

Spoof.—Dagonet's friend "the excellent Mr. Klein," has invented (?) an electric hair brush and an electric cigar lighter, and the *Referee* of last Sunday contained three lengthy paragraphs concerning these old-as-the-hills appliances, which go to show that Dagonet, who rather prides himself on being up-to-date, can be fairly described as a modern Rip-Van-Winkle, so far as his knowledge of electrical apparatus is concerned. The well-known coiffeur of Baker Street, who is also a great electrician, and a neighbour of Dagonet's, has done a most unneighbourly act in palming off the ancient platinum wire electric cigar lighter as his latest electric invention upon the unsuspicious and guileless representative of the *Referee*, who has been cleverly "spoofed."

Electric Light Tenders.—One would naturally assume that a specification drawn up by Prof. Ayrton would be explicit enough in every detail. Likewise it might reasonably be expected that firms of such standing as—taking two or three at haphazard—Paterson & Cooper, Sharp and Kent, and Roger Dawson, would not go very wide in their estimates. Taking the figures given by them as reliable, it seems strange to find the lowest tender (accepted) to be only £554, whereas the highest is £1,557. Indeed, a glance at the tenders sent in for lighting the new wards and other buildings of the North Western Fever Hospital at Haverstock Hill reveals a peculiar state of things, assuming that there is nothing left to chance in the specification.

Cataphoresis.—Dr. William J. Morton has courteously forwarded to us a copy of his exceedingly interesting paper on a new application of electricity to dental purposes. As an example of the phenomenon of cataphoresis, the article, which will be found in our present issue, is well worthy of careful study.

Embezzlement.—A clerk employed by the Charing Cross and Strand Electricity Supply Company was sentenced to four months' hard labour on 20th inst. for embezzling £26 odd from his employers.

NEW COMPANIES REGISTERED.

Lighting Corporation, Limited (44,648).—This company was registered on July 18th with a capital of £250,000, in £1 shares, to carry on the business of manufacturers of and dealers in incandescent lights and other apparatus, suppliers of light, heat, electricity, motive power, &c., electricians, gas workers and fitters, mechanical engineers, chemists, &c. The subscribers (with one share each) are:—H. R. Hartley, 4, Perham Road, W., gentleman: F. Dawkins, 13, Grangecourt Road, Stamford Hill, accountant; H. H. A. Herwig, 32, Queen's Road, Peckham, clerk; C. Darch, 95, Commercial Road, Peckham, clerk; E. E. Culley, 134, Manor Place, S.E., clerk; T. R. Bastard, 56, Cannon Street, E.C., solicitor; J. G. Baxter, Manor House, Wanstead, gentleman. The number of directors is not to be less than three nor more than seven. The subscribers are to appoint the first. Qualification £100; remuneration 10 per cent. of the net profits divisible. Registered by Rogers & Co., 56, Cannon Street, E.C.

New Phonopore Telephone Company, Limited (44,654).—This company was registered on July 19th with a capital of £10,000 in £1 shares (1,000 founder's), to enter into an agreement with the Phonopore Company, Limited, and to acquire, develop, work, and turn to account certain patented inventions connected with telephones, or telephonic, telegraphic, or other electrical apparatus. The subscribers (with one share each) are:—H. Seebohm, 22, Courtfield Gardens, S.W., steel manufacturer; T. J. Nash, 16—18, Aldgate, merchant; M. Mocatta, 10, Copthall Avenue, E.C., stockbroker; C. E. Spagnoletti, The Poplars, Aberdeen Place, N.W., electrical engineer; J. G. Chappell, 12, Billiter Street, E.C., tailor; W. F. Liddell, Warnford Court, E.C., stockjobber; C. Isaac, Faraday House, Charing Cross Road, W.C., secretary. The number of directors is not to be less than three nor more than seven. The subscribers are to appoint the first; qualification, £100: remuneration, £50 each per annum. Registered by Burton & Co., 23, Surrey Street, W.C.

Electric Ozone Syndicate, Limited (44,660).—This company was registered on July 19th with a capital of £12,000 in £10 shares, to acquire, turn to account, and deal with certain patent rights granted to E. Andreoli for generating and dealing with ozone by means of electricity, and using ozone for various purposes. The subscribers (with one share each) are:—C. Hanbury, 37, Lombard Street, E.C., druggist; F. J. Hanbury, 37, Lombard Street, E.C., chemist; W. P. Henderson, 85, Gracechurch Street, E.C., merchant; E. Andreoli, 18, Somerleyton Road, Brixton, journalist; R. Arnot, 1, Raymond Buildings, Gray's Inn, merchant; W. L. Castleden, 46, Steen Park, Richmond, secretary; G. Andreoli, 18, Somerleyton Road, S.W., electro-chemist. Registered, without articles of association, by Foss and Ledsam, 3, Abchurch Lane, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Chatham, Rochester, and District Electric Lighting Company, Limited (24,773).—The annual return of this company was filed on June 20th. The capital is £50,000, in £5 shares, and 3,860 have been taken up, 1,863 have been issued as fully-paid, and £5 per share has been called on 2,000, and £2 per share on 27; £10,051 10s. has been paid, leaving £2 10s. unpaid.

Metropolitan Electric Supply Company, Limited (25,395).—This company's annual return was filed on May 17th. The capital is £500,000 in £10 shares (100 founders'), and all have been taken up. 2,132 have been considered as paid, and the full amount has been called and paid on the remainder.

Norwich Electricity Company, Limited (30,694).—This company's annual return was filed on May 9th. 2,695 shares have been taken up, and paid for in full, out of a capital of £50,000 in £10 shares.

Canterbury Electricity Supply Company, Limited (38,780).—The registered office of this concern has just been removed from 49, Queen Victoria Street, London, E.C., to Moorgate Court, Moorgate Place, E.C.

General Electric Tramways Company, Limited (43,428).—The statutory return of this company was filed on July 5th. The capital is £50,000 in £1 shares, and 5,007 have been taken up and paid for in full.

CITY NOTES.

Eastern Telegraph Company, Limited.

THE meeting was held yesterday, at Winchester House, the Marquis of Tweeddale presiding in the absence of Sir John Pender.

In the course of his remarks, the CHAIRMAN said the gross revenue for the half-year showed an increase of £31,212. In message receipts there was a small decrease in the Indian, but a considerable increase in the Australian and Chinese traffic. There was also a marked increase in the traffic with South Africa, due, doubtless, to the activity in mining business. The negotiations regarding subsidies and reduced rates had concluded satisfactorily, and the arrangements effected with the Cape, Natal, and Transvaal, ensured the company

15 years prosperous traffic. The working expenses showed an increase of £3,220, but from that £2,293 for proportion of stationery had to be deducted, making the actual increase in the ordinary expenses only about £927, notwithstanding the large increase in the number of messages carried, which was nearly 100,000, or about 500,000 words. The working expenses at stations showed an actual increase (deducting the stationery item) of £1,396, which was due to extra staff, promotions, &c. Expenses attending repairs and renewals amounted to about £52,730 (increase £3,070). Credits received from other companies for the hire of ships showed an increase of about £8,000. The increased expenses under ships' account were due to about 300 miles of cable having to be laid into the original 1870 Aden-Bombay cable at the Bombay end. To the maintenance of ships' reserve fund £9,000 was carried (increase £4,000), and £100,000 was being carried forward against £110,000 in 1894. The reserve now amounted to £1,451,718, but the board considered it needed enlargement.

Mr. G. C. NICOL seconded the adoption of the report, and after a few questions had been put to the meeting and answered, the motion was carried, the meeting as usual concluding with votes of thanks to the chairman, directors and staff.

The Edison and Swan United Electric Light Company, Limited.

THE twelfth annual report, to be submitted at the ordinary general meeting to be held at Cannon Street Hotel on Monday, at two o'clock, states that the profit and loss account shows a credit balance of £25,876 3s. 2d. After providing for the interest accrued upon the £100,000 debenture stock, there remains a balance of £21,376 3s. 2d. available for distribution. An interim dividend at the rate of 5 per cent. per annum having already been paid in respect of the first half-year ending December, 1894, a further payment, at the rate of 5 per cent. per annum, in respect of the second half is recommended. The balance of £3,702 5s. 2d. being carried forward. The business of the company during the year has been satisfactorily maintained, notwithstanding the severe competition which has set in since the expiration of the company's patents. The liquidation of the Swan United Electric Light Company, Limited, is now practically completed, and the final meeting for winding up will shortly be held. The directors have to report the resignation of his seat at the board by Shelford Bidwell, Esq., F.R.S., and the election in his place of Joseph Wilson Swan, Esq., F.R.S. The Earl of Lichfield and Ernest Villiers, Esq., retire by rotation from the board, and offer themselves for re-election. Messrs. Welton, Jones & Co., the auditors, offer themselves for re-election.

The following notice also accompanies the report:—

The following resolution will be proposed, which, if passed, will be submitted to a subsequent extraordinary general meeting for confirmation as a special resolution, viz.:—

Resolved that the articles of association of the company be altered by striking out Article 87, and substituting therefor the following article:—

87. The amount from time to time declared by the board as available for dividend, including the amount, if any, recommended by them to be withdrawn from reserve for equalisation of dividends shall be applied as follows:—

1. There shall be first set aside thereout a sum equal to a preferential cumulative dividend of 7 per cent. per annum on the aggregate amount for the time being paid or credited as paid on the "A" shares.

2. Out of the sum so set aside there shall be paid a preferential cumulative dividend at the rate of 5 per cent. per annum on the amounts paid or credited as paid on the "A" shares, without distinction.

3. Subject thereto there shall be paid out of the sum so set aside a further cumulative dividend at the rate of 2 per cent. per annum on the amount paid, or credited as paid, on the "A" shares, provided that until all the "A" shares be fully paid, no "A" share, whether fully paid or not, shall for the purpose of this sub-section be deemed to have paid upon it more than the amount paid up or called up upon the "A" shares for the time being having the least amount called up or paid thereon.

4. The balance of the sum so directed to be set aside shall be carried to the reserve fund.

5. The residue of the amount declared to be available for dividend, after setting aside the sum mentioned in sub-section 1, shall be applied in payment of dividends *pari passu* on the amounts paid up or credited as paid on the "A" or "B" shares; but so that for the purposes of this sub-section, the amounts to be deemed paid up on the "A" shares shall be ascertained as in the case of sub-section 3.

City and South London Railway Company, Limited.

THE report of the directors for the half-year ending June 30th, 1895, to be submitted to the half-yearly ordinary general meeting of the company, to be held at Winchester House, Old Broad Street, in the City of London, on Monday, July 29th, 1895, at 3 o'clock in the afternoon, states that the receipts from all sources for the past half-year have amounted to £24,401 15s. 8d., and the cost of working has been £15,019 16s., leaving a profit of £9,381 19s. 8d. Inclusive of the balance brought forward from December 31st last, the net revenue account shows an aggregate total of £10,379 8s. 8d. After making provision for the debenture and debenture stock interest, a balance remains available for dividend of £6,420 16s. 2d. Out of this sum the directors recommend that the full dividend of 5 per cent. per annum be paid on the preference shares, and that a dividend at the rate of 1½ per cent. per annum be paid upon the consolidated ordinary stock, leaving a balance of £964 11s. 2d. to be carried forward to the next account. The following table shows the number of passengers, exclusive of season ticket holders, carried since the opening of the railway in each half-year:—

Half-year ended	Number of passengers (exclusive of season ticket holders).	Receipts (including season tickets).
		£ s. d.
December 31st, 1890 (11 days)...	165,000	1,568 3 9
June 30th, 1891	2,412,343	19,403 6 9
December 31st, 1891	2,749,055	19,798 16 6
June 30th, 1892	2,813,162	20,931 4 2
December 31st, 1892	3,117,602	22,002 17 5
June 30th, 1893	3,146,656	22,458 6 9
December 31st, 1893	3,093,351	22,067 14 10
June 30th, 1894	3,383,154	23,564 10 6
December 31st, 1894	3,275,649	23,540 12 4
June 30th, 1895	3,113,199	23,711 5 8
Total since opening of the line	27,269,171	£199,046 18 8

During the first three months of the present year there was a satisfactory growth of the traffic on the line, but the very hot and fine weather of the last three months affected it so much that the increase was not only checked, but a small decrease resulted as compared with the same quarter last year. This was very disappointing, as the directors had confidently looked forward to a considerable increase in the traffic during the past half-year. Considering, however, the very large diminution which has taken place in the traffic of nearly all the railway companies in the kingdom during the same period, the directors are glad that the receipts still show an increase, however small. In accordance with the authority given at the last half-yearly meeting, detailed plans have been prepared for the extension to Finsbury Pavement, and negotiations have been entered into for the purchase of some of the property, but the arrangements are not yet sufficiently completed to enable a report to be made to the shareholders on the present occasion. During the past six months a further sum of £23,200 terminable mortgage debenture bonds has been paid off. The Bill for the extension of time for the works of the Clapham Extension Act, 1890, and for other purposes, received the Royal assent on May 14th, 1895. A contract has been let for the construction of the new siding at Stockwell. This, when completed, will enable the work at that station to be carried on with greater economy and convenience.

Anglo-American Telegraph Company, Limited.

THE report of the directors, to be submitted to the ordinary general half-yearly meeting of the proprietors, to be held at Winchester House, 50, Old Broad Street, London, on Friday, July 26th, at 2 o'clock, p.m., states that the total receipts from January 1st to June 30th, 1895, including the balance of £485 6s. 2d. brought forward from the last account, amounted to £141,715 4s. 11d. This sum, however, is subject to revision, as the financial result of the judgment given in favour of this company against the Paris and New York Telegraph Company cannot yet be determined. The traffic receipts show an increase of £9,382, as compared with the corresponding period of last year. The total expenses of the half-year, including the repair of cables, &c., as shown by the revenue account, amounted to £55,384 2s. 4d., being a decrease of £332 13s. 2d. The directors, under the powers conferred upon them by the articles of association, have, before declaring the net profits, set apart the sum of £12,000 to the renewal fund, leaving a balance of £74,331 2s. 7d. One quarterly interim dividend of 10s. per cent. on the ordinary stock, and of £1 per cent. on the preferred stock, was paid on May 1st, 1895, absorbing £35,000, and a second quarterly dividend of 11s. per cent. on the ordinary stock, and £1 2s. per cent. on the preferred stock, amounting to £38,500, will be paid on August 1st, 1895, leaving a balance of £831 2s. 7d. to be carried forward to the next account. The company's repairing ss. *Minia* has been employed during the past half year in the repair of the 1874 cable, broken off the coast of Ireland, and of two of the cables connecting Newfoundland with Cape Breton. She has also been employed by the Direct United States Cable Company for the repair of a cable belonging to that company, the payment for which appears in the revenue account.

The Globe Telegraph and Trust Company, Limited.

THE report of the directors to be submitted to the twenty-second ordinary general meeting, on July 26th, 1895, states that the balance-sheet and accounts for the year ending July 18th, 1895, with statement of the stocks and shares held by the company at that date, are herewith submitted. The net revenue of the company for the year, after deduction of expenses, amounts to £179,465 6s., and makes, with the balance of £527 2s. 4d. brought forward, a total of £179,992 8s. 4d. From this amount there has been distributed the sum of £123,361 5s. 5d. in interim dividends, leaving an available

balance of £56,631 2s. 11d. The directors recommend the payment of a final dividend for the year of 3s. per share on the preference shares, and of 3s. 3d. per share on the ordinary shares, making, with the previous distributions, a total dividend for the year of 6 per cent., less income tax, upon the preference, and 4½ per cent. net (against 4½ per cent. for the preceding year) upon the ordinary shares, and carrying forward a balance of £1,238 3s. 4d. Since the last meeting a further sum of £38,592 9s. 7d., resulting from the paying off of the Direct Spanish Telegraph Company's 6 per cent. debentures, has been invested as follows:—520 ordinary shares in the Direct Spanish Telegraph Company, 102 certificates in the Submarine Cables Trust, 1,135 shares in the Western Union Telegraph Company, 400 shares in the Cuba Submarine Telegraph Company—the remainder will be invested in suitable securities. The directors have to report that Sir Henry D. Gooch, Bart., has resigned his seat at the board; it is not proposed to fill the vacancy at present. In conformity with the articles of association two of the directors, viz., Sir John Pender, G.C.M.G, and the Hon. St. John Brodrick, M.P., retire, and, being eligible, offer themselves for re-election. The auditors, Messrs. Deloitte, Dever, Griffiths & Co., and Mr. William Griffith, B.A., barrister-at-law, also retire, and offer themselves for re-election.

Westinghouse Electric and Manufacturing Company, Limited.

THE annual report of this company for the year ended March 31st, 1895, was issued in New York on July 2nd. New works have been opened at East Pittsburgh during the year. The removal of plant and materials from the old to the new works has had the effect of reducing the output for the year to about three-quarters of what it would have been without the interruption and extra work. So far as ascertained, there was expended directly in removing the machinery and material $90,499.54, after deducting which from the earnings from business and from other sources, there is left a net profit of $711,909.68. The new works have room for the employment of between 4,000 and 5,000 men. The directors consider the demand for electrical apparatus in general will be greater during the next 12 months than for any period in the past. The company has for the past six years been interested in two important light and power properties, namely, the United Electric Light and Power Company, of New York, and the Brush Electric Company, Baltimore, Md. During the past year both of these companies, with the assistance of the Westinghouse Company, have carried through financial plans which have put them on a prosperous business basis, and have given a large increase to the value of their securities held by this company. The United Company is now completing, and will soon have in operation, one of the most comprehensive light and power stations in the United States. It has contracted with the Westinghouse Company for 10 complete electrical outfits of 1,000 H.P. each, and for all the converters and other needed apparatus, half of these outfits having been used for the World's Fair lighting. The fields of operation of the companies mentioned are unusually profitable ones, and it is believed that the value of the securities of both properties will, in the near future, be equal to, or above, their par value (amounting to $2,791,100), and that the final profit to this company on these securities will be a large one. During the past year the company sold additional patent rights to the Westinghouse Electric Company, Limited, and with the proceeds purchased the preferred and common stock of a number of English holders, so that the company now owns $782,500 preferred and $1,307,400 common stock (together, $2,089,900) out of $2,322,750 outstanding, and this company will hereafter direct all of its affairs. All apparatus sold by the London company has been purchased from this company at profitable rates, and the business of the London company has always been profitable, last year having netted nearly 5 per cent. on a valuation of $1,000,000. It is proposed to push the business in Great Britain, Continental Europe, and in the various colonies, in order to increase the sales of the company's product, there having been many inquiries during the past year which the company has been unable to respond to, owing to lack of manufacturing facilities. It is believed that the new prices which the company has been able to make to the London company will enable its management to largely increase its sales, and give a permanent value to all of this company's stock in that company. After referring to the incandescent lamp feeder and main, and other patent litigation in which the company has been engaged during the period, the report refers to street railways operated by underground electric circuits, the company having secured the controlling interest in the stock of the Electro-Magnetic Traction Company, of West Virginia, thereby also securing the control of valuable inventions under this head. The company owns the exclusive right to manufacture and sell apparatus under the patents of Nikola Tesla. All the machinery in the company's new factory is driven by Tesla multiphase motors, and orders for like apparatus have followed its inspection. The Niagara generators have been put in successful operation, and other important installations for power transmission plant under the Tesla patents have been made in various parts of the United States. The company is pushing forward the manufacture of multiphase motors under the Tesla patents for practical tests in running standard cars on elevated roads and long lines. Suits under the Tesla patents are pending against two companies. The report states that while heretofore a very large percentage of the business of the States has been done by means of continuous current apparatus, it is now estimated by experts that the percentage will change, so that in the near future the bulk of the business will be done by means of alternating current multiphase apparatus, involving the use of Tesla's important inventions. The balance-sheet presents the following figures:—Assets, $16,314,241.09, which, after deducting liabilities, leaves a surplus balance at March 31st of $3,979,400.21.

The Gülcher (New) Electric Light and Pow Company, Limited (in Liquidation).

MR. C. FITCH KEMP, the voluntary liquidator, has issued the following report to the shareholders:—

"Notice is hereby given that an extraordinary general meeting of the above-named company will be held at 73, Lombard Street, in the City of London, at 2.30 o'clock in the afternoon, on Monday, the 29th day of July, 1895, for the purposes following, namely:—

"1. To receive and consider the account of the liquidator, showing his acts and dealings, and the manner in which the winding up has been conducted during the preceding year and since the commencement of the winding up.

"2. To consider, and if approved to authorise, the acceptance of an offer which has been received by the liquidator to purchase of and from him at the price of £2 10s. per share, 680 ordinary shares of £10 each, fully paid in Easton, Anderson & Goolden, Limited.

"3. To transact such other business as may be necessary and proper.

"Dated July 19th, 1895.

"C. FITCH KEMP, *Voluntary Liquidator.*

"73, Lombard Street, London."

STATEMENT OF RECEIPTS AND PAYMENTS,
From June 4th, 1894, to June 30th, 1895.

RECEIPTS.

	£	s.	d.	£	s.	d.
To Sales of stock and plant—						
Per Easton, Anderson & Goolden, Limited	12,500	0	0			
Sundries	30	12	8			
				12,530	12	8
(The liquidator was authorised to accept, as part-payment of the above sum of £12,500, the transfer of 680 £10 shares in the company at par, and cash £5,700, see *contra*.)						
„ Book debts	...	...	...	888	11	3
„ Loan from Lloyds Bank, Limited	4,000	0	0			
Less amount repaid to date ...	1,500	0	0			
				2,500	0	0
„ Calls collected (hypothecated to Lloyd's Bank, Limited, as holders of second debentures, see *contra*)				1,429	1	4
				£17,348	5	3

PAYMENTS.

	£	s.	d.	£	s.	d.
By Preferential payments for rents, rates, salaries, &c				520	1	1
„ First mortgage debentures, redeemed				5,289	16	4
„ Stamps and transfer fees on debentures				88	2	6
„ Easton, Anderson & Goolden, Limited (see *contra*):—						
For 680 shares at £10	6,800	0	0			
Purchase of £3,000 second mortgage debentures at 97½	2,925	0	0			
				9,725	0	0
„ Taxed costs in debenture holders' action				182	13	10
„ Fire insurance and sundry incidental expenses				23	13	10
„ Lloyds Bank, Limited—						
Interest on loan				66	18	5
On account of principal and interest due on second debentures held by them				1,392	5	7
„ Cash at Bank—						
Liquidators' general account ...	22	17	11			
Call account (to be paid to Lloyds Bank, as above) ...	36	15	9			
				59	13	8
				£17,348	5	3

FIRST ANNUAL REPORT OF MR. CHARLES FITCH KEMP, THE VOLUNTARY LIQUIDATOR OF THE ABOVE-NAMED COMPANY.

In submitting my first report and statement of accounts, I have to remind the creditors and contributories that the basis upon which I accepted the liquidation of this company was shortly as follows:—That cash assets, viz, the stock-in-trade and plant, and a debt owing to the company in New Zealand from the New Zealand Electrical Syndicate, would be sufficient to pay off the first debentures; that the uncalled capital of the company would be sufficient to pay off the second debentures, and would probably provide a surplus of cash which would pay a substantial dividend to third debenture holders, and that, ultimately, the unsecured creditors would be fully paid, and some return would be made on the share capital, when time had been given to realise the holding of the company in the shares of the New Zealand Electrical Syndicate.

This forecast of liquidation appeared at the time to be based on reliable grounds, but it has entirely failed of realisation, owing to two main causes, and the position now is that I have borrowed the sum of £3,000 on a transfer of the first debentures (which have otherwise been paid off), and that there remains due on that loan about £2,500, and that the only assets immediately available to meet that loan are the shares in Easton, Anderson & Goolden, Limited, hereinafter more particularly referred to. The uncalled capital will not be sufficient to pay off the second debentures of the company, and the realisation of the cash assets in New Zealand is indefinitely postponed.

I have already said that there are two main causes which have led to this unfortunate result. The first and leading cause is the break-down of the firm of Miles & Co., Limited. A director of that company was also a director of this company, and he approved and endorsed the scheme for settlement of the affairs of this company, which was submitted to me as before-mentioned, but the keystone of the scheme was the payment by the contributories of the amount due from them, and Miles & Co., Limited, were responsible to this company for no less a sum than £3,500, none of which I have yet been able to collect. Consequently, the claim of the second debentures, instead of being fully-paid off and leaving a tangible surplus, remains unsatisfied, and unless, therefore, a very substantial dividend is recovered from Miles & Co., Limited, as to which I am unable to speak, I can see no immediate prospect of discharging them.

The other cause is this:—The plant of the company in New Zealand was taken over by the New Zealand Electrical Syndicate as a going concern, and upon terms of repayment out of realisation, which it was calculated would rapidly place this company in the possession of funds. The debt was calculated to amount altogether to between £3,000 and £4,000, which would have been remitted from time to time as moneys were collected, but the New Zealand Electrical Syndicate had executed debentures on which default had not arisen, and which debentures were held by the Gas and Water Trust. The Gas and Water Trust, as holders of these debentures, procured from the New Zealand Electrical Syndicate, by vote of a majority of the board, which had then control, a resolution in favour of the appointment of a receiver.

Now, without encumbering this report with the details of disputes which arose between the shareholders of the Electrical Syndicate and the Gas and Water Trust, I was compelled to take steps to protect the interests of this company in the assets of the syndicate, as I was advised that the syndicate's existence depends wholly upon the concessions and contracts it has secured in New Zealand and its Act of Parliament there, and that the appointment of a receiver might have a most disastrous effect upon all interests in the company, whether of debenture or share capital. I thought that the gravity of the step taken by the Gas and Water Trust had not been adequately considered, and I instructed the solicitors acting for me in this liquidation to recall the shares to which I am entitled as liquidator, and which had been outstanding in the name of Mr. Roderick Pryor and had been used by him for the purpose of qualifying as directors the nominees of the Gas and Water Trust. In this way I have reacquired some share in the control of the syndicate, but I have every desire and intention of co-operating with the Gas and Water Trust in the management, so as to duly preserve the interest of the debenture holders and yet secure to the shareholders that value which I am advised and believe may be still considered to remain in their holdings. I see no reason to doubt that I shall succeed in this, and that ultimately the debt of £3,000 and upwards, and also the nominal capital exceeding £20,000 which I, as liquidator, hold in the New Zealand Electrical Syndicate will become valuable assets, but in the meantime the result of the disputes referred to has been, so far, adverse to the present realisation that the cash assets in New Zealand which, when I entered upon my liquidation, I hoped to have received, prior to this date, still remain in that country, and there is no prospect of immediate remittance.

I will now recall the attention of the contributories to the resolution which was passed at the meeting held on August 1st, 1894, authorising me to enter into an arrangement with Easton, Anderson and Goolden, Limited, for the sale to that company of the company's plant, machinery, stock-in-trade at the price of £12,500, payable as to £5,700 part thereof in cash, and as to £6,500, the balance thereof, in 680 shares of £10 each, fully paid, in Easton, Anderson & Goolden, Limited. I informed the gentlemen who were present at that meeting that I was advised not only that the offer was highly beneficial, but that the cash paid was alone greater than I could have expected to receive at a break-up price. The shares, therefore, were taken for what might be their value, it being well known that there was no market for them at that time, and that they were not earning dividend. The solicitors acting in this liquidation are also solicitors for Easton, Anderson & Goolden, Limited, and they have procured for me from another client of theirs an offer of 5s. in the £ for these shares—that is, £1,700. There is no market for the shares, and I am not able to say anything as to their intrinsic value, but I do know that there is a very considerable issue of debentures in front of them. It is only, therefore, from those who are in some way interested in the company that an offer can be obtained.

If this meeting authorises me to accept that offer, I shall, after discharging the expenses of the liquidation to date, apply the moneys obtained in further reduction of the £2,500 which remains owing on the security of the first debentures, as it is obvious that until those first debentures are discharged there can be no payment to the unsecured creditors.

In conclusion, I can only say, gentlemen, that while I do not take at all a despondent view of the ultimate realisation of the assets of this company, I cannot hold out to you the hope that funds will reach my hands available for dividend at any early date.

C. Fitch Kemp, *Voluntary Liquidator.*

The Direct United States Cable Company, Limited.

The report of the directors for the six months ended June 30th, 1895, to be presented at the thirty-sixth ordinary general meeting of the company, to be held at Winchester House (Hall No. 174), 50, Old Broad Street, in the City of London, on Tuesday, the 30th day of July, 1895, at 2 o'clock p.m., states that herewith the directors submit the usual statements of account for the half-year ended June 30th, 1895, which, with the half-year's accounts to December 31st last, presented at the ordinary general meeting on January 25th last, show the financial result of the eighteenth year's working of the company. The half-year's revenue, after deducting outpayments, amounted to £37,653 2s. 4d., as compared with £34,843 9s. 4d. for the corresponding period of 1894, being a difference of £2,809 13s. in favour of the half-year under review. The working and other expenses for the same period, including income-tax, but exclusive of cost of repairs of cables, amounted to £18,909 0s. 10d., leaving a balance of £18,744 1s. 6d. as the net profit of the half-year, making, with £1,807 19s. 3d. brought forward from the previous half-year, a total of £20,552 0s. 9d. For the corresponding period of 1894, the working expenses and other payments amounted to £18,750 3s. Three quarterly interim dividends, amounting to £18,213, have been declared and paid during the financial year, and a final payment of 2s. per share is now proposed, making, with the three interim dividends, 2 per cent. for the year, being a total distribution of £24,284. After transferring £7,000 to the reserve fund account, the balance of £1,410 0s. 9d. on the revenue account is proposed to be carried forward. During the period under review, repairs of the company's cables have cost £1,730 7s. 4d. This amount together with £673 14s. 8d. written off the buildings' account, Ballinskelligs, in respect of old buildings pulled down, have been debited to the reserve fund account, the balance of which, with the addition of interest, profit, and amount transferred from revenue account, now stands at £298,369 18s. 10d. Pursuant to the provisions of the articles of association, two of the directors, viz.: Charles E. Günther, Esq., and Admiral of the Fleet The Hon. Sir Henry Keppel, G.C.B., D.C.L., retire by rotation, and being eligible, offer themselves for re-election. Messrs. Deloitte, Dever, Griffiths & Co., and Messrs. J. and J. Sawyer & Co., the auditors, retire pursuant to the articles of association, and offer themselves for re-election.

Telegraph Construction and Maintenance Company, Limited.

The half-yearly general meeting of this company was held on Tuesday at the offices, Old Broad Street.

Admiral Sir G. H. Richards, who presided, stated that the present year had not been a good one for the manufacture of telegraph cables, which, however, were not articles of everyday use, and they did not look forward every year to obtain any very great telegraph work. It was, however, not at all an unusual thing occasionally to have a slack time in the manufacture of submarine cables. As regarded their general trade, the gutta-percha work, it had been slightly better than it was at the same time last year.

The Printing Telegraph and Construction Company of the Agence Havas, Limited.—At an extraordinary general meeting of the company, held at 12, King William Street, E.C., on July 4th, 1895, it was resolved: "That it having been proved to the satisfaction of this meeting that the company cannot by reason of its liabilities continue its business, the company be wound up voluntarily," and Mr. W. H. King, of 13 and 14, Basinghall Street, E.C., was appointed liquidator.

The Westminster Electric Supply Corporation, Limited.—The board of the Westminster Electric Supply Corporation, Limited, have declared an interim dividend for the half-year ending June 30th, 1895, at the rate of 5 per cent. per annum, payable on September 1st, to shareholders whose names were on the register on July 24th.

Venezuela Telephone and Electrical Appliances Company, Limited.—Coupon No. 10 of the 5 per cent. first mortgage debentures, due July 31st, will be paid from that date at the Consolidated Bank, Threadneedle Street, or at Messrs. Westendorp and Co.'s Bank, Amsterdam.

Cuba Submarine Telegraph Company, Limited.—The directors have resolved to recommend the payment of a dividend on the ordinary shares at the rate of 8 per cent. per annum.

West African Telegraph Company.—The meeting of this company was held at Winchester House, yesterday (Thursday) afternoon, for the adoption of the report.

The City of London Electric Lighting Company, Limited.—The warrants for the interim dividend on the 6 per cent. preference shares have now been posted.

TRAFFIC RECEIPTS.

The City and South London Railway Company. The receipts for the week ending July 21st, 1895, amounted to £831; week ending July 22nd, 1894, £809; decrease, £3; total receipts for half-year, 1895, £2,594; corresponding period, 1894, £2,600; decrease, £6.

The Liverpool Overhead Railway Company. The receipts of this railway for the week ending July 21st, 1895, amounted to £1,226; corresponding week last year, £1,034; increase £192.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending July 19th, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £3,078.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1892.	1893.	1894.	Closing Quotation, July 17th.	Closing Quotation July 24th.	Business done during week ended July 24th, 1895. Highest.	Lowest.
173,400*l*	African Direct Teleg., Ltd., 4 % Deb.	100	...	4 %	4 %	102 —105	102 —105	101½	...
1,012,880*l*	Anglo-American Teleg., Ltd.	Stock	£2 15s.	£2 11s.	£2 2s.	47 — 49	47 — 49	47	...
2,993,560*l*	Do. do. 6 % Pref.	Stock	£5 10s.	£5 2s.	£4 4s.	88½— 89½	88½— 89½	89½	88¾
2,993,560*l*	Do. do. Defd.	Stock	...	...	...	8¼— 8¾	8¼— 8¾	8⅜	...
130,000	Brazilian Submarine Teleg., Ltd.	10	6½% §	6½% §	...	13½— 14	13½— 14	14	13¾
75,000*l*	Do. do. 5 %, Debs., 2nd series, 1906	100	5 %	5 %	...	111 —115	111 —115	...	...
44,000	Chili Telep., Ltd., Nos. 1 to 44,000	5	10%‖ §	... §	2½%	3 — 4	3 — 4	...	...
10,000,000$	Commercial Cable Co.	$100	7 %	7 %	7 %	160 —165	160 —165	162	...
224,850	Consolidated Telep. Const. and Main., Ltd.	10/-	2 % §	2 % §	1½%	1/16— 3/16	1/16— 3/16	...	...
16,000	Cuba Teleg., Ltd.	10	8 %	8 %	8 %	13 — 14	13 — 14	...	...
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	20 — 21	20 — 21	...	...
12,931	Direct Spanish Teleg., Ltd.	5	4 %	4 %	4 %	3½— 4½	3½— 4½	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	10 %	9¾— 10½	9¾— 10½	...	...
30,000*l*	Do. do. 4½ % Debs Nos. 1 to 6,000 ...	50	...	...	4½%	103 —106 xd	103 —106⅝	104½	...
60,710	Direct United States Cable, Ltd.	20	3½% §	2⅝% §	2 %	9½— 9¾	9½— 9¾	...	...
400,000	Eastern Teleg., Ltd., Nos. 1 to 400,000	10	6½% §	6½% §	6½%	16¾— 17	16¾— 17⅛	17⅛	16 13/16
70,000	Do. 6 % Cum. Pref.	10	6 % §	6 % §	6 %	17½— 18	17¾— 18¼	18	17⅞
102,100*l*	Do. 5 % Debs., repay. August, 1899	100	5 %	5 %	5 %	107 —110	107 —110	...	...
1,297,837*l*	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	4 %	125 —128	124 —129	127	126½
250,000	Eastern Extension, Australasia and China Teleg., Ltd. ...	10	7 %	7 %	7 %	17½— 17¾	17½— 17½	17½	17¼
54,100*l*	Do. 5 % (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326	100	5 %	5 %	5 %	102 —106 xd	102 —106	103	...
194,300*l*	Do. do. Bearer, 1,050—3,975 and 4,327—6,400	100	5 %	5 %	5 %	103 —106 xd	103 —106	...	...
320,000*l*	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	126 —129	127 —130	128½	128
80,600*l*	Eastern and South African Teleg., Ltd., 5 % Mort. Deb. 1900 redeem. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	5 %	5 %	102 —106 xd	102 —106	...	...
107,600*l*	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	5 %	5 %	103 —106	103 —106	...	...
300,000*l*	Do. 4 % Mort. Debs. Nos. 1 to 3,000, red. 1909	100	4 %	4 %	4 %	107 —110	107 —110	...	...
200,000*l*	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	112 —115	112 —115%	114½	...
180,227	Globe Telegraph and Trust, Ltd.	10	4½% §	4⅝% §	4⅛%	10⅛— 10⅜	10⅛— 10⅜	10⅜	10⅛
180,042	Do. do. 6 % Pref.	10	6 % §	6 % §	6 %	17 — 17½	17 — 17½	17⅛	17
150,000	Great Northern Teleg. Company of Copenhagen	10	8⅜% §	8⅜% §	8⅜%	21¾— 22¼xd	21¾— 22¼	21⅞	...
180,000*l*	Do. do. do. 5 % Debs.	100	5 %	5 %	5 %	105 —108	105 —108	...	...
17,000	Indo-European Teleg., Ltd.	25	10 %	10 %	10 %	49 — 52	49 — 52	51½	50
37,548	London Platino-Brazilian Teleg., Ltd.	10	2 %	2½%	1¼%	5 — 7	5 — 7	...	...
100,000*l*	Do. do. 6 % Debs.	100	6 %	6 %	6 %	107 —111	107 —111	...	...
28,000	Monte Video Teleph. Co., 6% Pref., 1 to 28,000	5	*nil*	4 %	...	1½— 2½	1½— 2½	...	...
484,597	National Teleph., Ltd., 1 to 484,597	5	5 % §	5 % §	5 %	5⅝— 6¼	5⅝— 6⅛	6⅛	5⅞
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	16 — 17	16 — 17	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	15 — 16	15 — 16	15⅝	15⅜
119,234	Do. 5 % Non-cum. 3rd Pref., 1 to 119,234	5	5 %	5 %	5 %	5⅞— 6⅛	5⅞— 6⅛	6 1/16	...
1,100,000*l*	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	105 —107 xd	105 —107	106	105
171,504	Oriental Teleph. & Elec., Ltd., Nos. 1 to 171,504, fully paid	1	...	...	4¼%	2/16— 1¼	2/16— 1¼	...	...
100,000*l*	Pacific and European Tel., Ltd., 4 % Guar. Debs, 1 to 1,000	100	4 %	4 %	4 %	107 —110	107 —110	...	...
11,839	Reuter's Ltd.	8	5 %	0 %	*nil*	3½— 4½	3½— 4½	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	123 —128	124 —129	127½	125
58,000	United River Plate Teleph., Ltd.	5	...	...	...	2½— 3	2½— 3	...	...
146,733*l*	Do. do. 5 % Debs.	Stock	5 %	5 %	5 %	92 — 97 xd	92 — 97	...	...
15,609	West African Teleg., Ltd., 7,501 to 23,109	10	..	...	*nil*	5½— 6½	5½— 6½	...	...
238,300*l*	Do. do. do. 5 % Debs.	100	5 %	5 %	5 %	104 —107	104 —107	...	...
30,000	West Coast of America Teleg., Ltd.	10	...	...	...	1½— 2½	1½— 2½	...	...
150,000*l*	Do. do. do. 8 % Debs., repay. 1902	100	8 %	8 %	...	99 —101	99 —104	...	...
64,248	Western and Brazilian Teleg., Ltd.	15	2½%	2½%	3 %	10⅜— 11¼	10½— 11	10 1/16	10⅝
33,129	Do. do. do. 5 % Pref. Ord. ...	7½	5 %	5 %	5 %	6½— 7	6½— 7	6¾	...
33,129	Do. do. do. Def. Ord.	7½	...	...	1 %	4½— 5	4¼— 4⅜	...	...
165,200*l*	Do. do. do. 6% Debs. "A," 1880 Red.	100	6 %	6 %	6 %	104 —108	104 —108	...	...
206,400*l*	Do. do. do. do "B," do.	100	6 %	6 %	6 %	104 —108	104 —108	...	...
88,321	West India and Panama Teleg., Ltd.	10	⅛%	7/8%	¼%	¾— 1	¾— 1	...	...
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	10 — 10½	10 — 10½	...	...
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	8½— 9½	8½— 9½	...	...
80,000*l*	Do. do. 5 % Debs. No. 1 to 1,800 ...	100	5 %	5 %	5 %	110 —113	110 —113	...	...
1,777,000$	Western Union of U. S. Teleg., 7 % 1st Mort. Bonds ...	$1000	7 %	7 %	7 %	113 —118	113 —118	...	...
164,300*l*	Do. do. 6 % Ster. Bonds.	100	6 %	6 %	6 %	102 —104	102 —104	...	...

ELECTRICITY SUPPLY COMPANIES.

30,000	Charing Cross and Strand Electy. Supply	5	5 %	4½%	4½%	5½— 5⅝	5½— 5⅝	5⅝	5 9/16
40,000	City of London Elec. Lightg. Co., Ltd., Ord. 40,001—80,000	10	...	...	5 %	14½— 15½	14 — 15	14½	14½
40,000	Do. do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	16 — 17	16 — 17	16 1/16	15 15/16
300,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	5 %	131 —134	131 —134	133	...
22,475	County of London and Brush Prov. Elec. Ligtg., Ltd., Ord. 1—22,475	10	...	...	...	9 — 10	8½— 9½	...	...
10,000	Do. do. do. 6% Pref., £4 pd., 40,001—50,000	10	...	...	...	6 — 6½	6 — 6½	...	...
50,000	†Liverpool Electric Supply, all paid	5	5 %	5 %	5½%	7⅜— 7⅞xd	7⅜— 7⅞xd	...	...
49,900	*Metropolitan Electric Supply, Ltd., 101 to 50,000 ...	10	2 %	2½%	3 %	10½ — 11	10½— 11	11	10¾
150,000*l*	Do. 4½% first mortgage debenture stock	...	4½%	4½%	...	116 —119	116 —119	...	...
6,452	Notting Hill Electric Lightg. Co., Ltd.	10	...	...	1 %	8¼— 8⅜	8¼— 8⅜	...	...
19,980	St. James's & Pall Mall Elec. Light Co., Ltd., Ord., 101-20,080	5	7½%	4½%	6½%	8 — 8½	8 — 8½	8 5/16	...
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	9 — 9½	9 — 9½	9½	...
59,900	*Westminster Electric Supply Corp., Ord., 101 to 60,000 ...	5	3½%	4 %	5 %	7¾— 8¼	7⅞— 8¼	7 15/16	7⅞
8,000	Do. do. do. Ord., 60,001 to 68,000 ...	5	...	...	...	7½— 8	7½— 8	...	...

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.

Unless otherwise stated all shares are fully paid. ‖ Dividends paid in deferred share warrants, profits being used as capital

Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL, COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1892.	1893.	1894.	Closing Quotation, July 17th.	Closing Quotation, July 24th.	Business done during week ended July 24th, 1895. Highest.	Lowest.
90,000	Brush Elecl. Enging. Co., Ord., 1 to 90,000...	3	6 %§	6 %§	...	2¼— 2⅜	2⅛— 2⅜	2⅜	2 3/16
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	6 %§	6 %§	...	2⅛— 2⅜	2⅛— 2⅜	2¼	2⅛
125,000*l*	Do. do. 4½ % Perp. Deb. Stock.... ...	Stock	4½%	4½%	...	112 —115	112 —115	...	...
630,000*l*	City and South London Railway	Stock	5/8%	5/8%	1¼%	42 — 44	42 — 44	...	...
28,180	Crompton & Co., Ltd., 7 % Cum. Pref. Shares, 1 to 28,180	5	7 %§	7 %§	...	2 — 2⅛	2 — 2⅛	...	...
89,261	Edison & Swan United Elec. Lgt., Ltd., "A" shrs, £3 pd. 1 to 89,261	5	...	...	5 %	1⅞— 2¼	2 — 2⅛	2¼	2 1/16
100,000	Do. do. do. 4½% Deb. Stock Red....	Stock	...	...	4½%	104 —107	104 —107	...	...
110,000	Electric Construction, Ltd., 1 to 110,000	2	*nil*	*nil*	...	⅝— ¾	¾— 1	1 1/16	¾
12,845	Do. do. 7 % Cum. Pref., 1 to 12,845 ...	2	7 %	7 %	...	2 — 2⅛	2 — 2⅛	...	...
91,195	Elmore's Patent Cop. Deposg., Ltd., 1 to 70,000	2	*nil*	*nil*	...	⅞— 1⅛	1 7/16— 1 5/16	1 1/16	...
69,385	Elmore's Wire Mfg., Ltd., 1 to 69,385, issued at 1 pm. ...	2	*nil*	*nil*	...	1 — 1¼	1 — 1¼	1 1/16	...
20,000	Fowler-Waring Cables, Nos. 301 to 20,300	5	*nil* §§	*nil* §	...	¼— ⅜	¼— ⅜	...	...
9,600*l*	Greenwood & Batley, Ltd., 7 % Cum. Pref., 1 to 9,600 ...	10	7 %	*nil*	...	6½— 7½	6½— 7½	...	...
7,000	Henley's (W. T.) Telegraph Works, Ltd., Ord.	10	5 %	5 %	6 %	10½— 11½	10½— 11½	...	...
3,000	Do. do. do. 7% Pref.	10	...	...	...	14 — 15	14 — 15	14 7/8	...
50,000	Do. do. do. 4½ Mort. Deb. Stock	Stock	...	...	...	104 —107	104 —107	...	...
50,000	India-Rubber, Gutta Percha and Teleg. Works, Ltd. ...	10	12½%	12½%	10 %	19 — 20	19 — 21	20	19½
200,000*l*	Do. do. do. 4½ % Deb., 1896	100	4½%	4½%	4½%	102 —104	102 —104	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	...	1 %	1½%	10 7/16— 10 9/16	10 13/16— 10 15/16	10 13/16	...
10,000	† Do. do. Pref., £10 paid	10	...	5 %	5 %	15½— 15¾	14¾— 15¼	...	...
37,350	Telegraph Constn. and Maintce., Ltd.	12	15 %	20 %	20 %	43 — 45	43 — 45	44½	42
150,000	Do. do. do. 5 % Bonds, red. 1899	100	5 %	5 %	5 %	104 —107 xd	104 —107	...	...
54,000*l*	Waterloo and City Railway, Nos. 1 to 54,000, £4 paid ...	10	...	...	...	4⅜— 4⅝	4⅜— 4⅝	4⅝	4 9/16

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ Last dividend paid was 50% for 1890.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.
Crompton & Co.—The dividends paid on the ordinary shares (which have not a Stock Exchange quotation), are as follows: 1892—0%§; 1891—7%§; 1890—8%§.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Birmingham Electric Supply Company, Ordinary of £5 (fully paid), 5⅜—6¼.
Chelsea Electricity Supply Ord., 6¾—7¼.
Do. do. do. Pref., 7—7½.
Electric Construction Corporation, 6 % Debentures, 85—90.
House-to-House Company (£5 paid), 4—4½.
Do. do. 7 % Preference, of £5, 7⅜—8¼.
Do. do. 4½% Debentures of £100, 107—109.
Kensington and Knightsbridge Electric Lighting Company, Limited Ordinary Shares £5 (fully paid) 7½—8; 1st Preference Cumulative 6 %, £5 (fully paid), 7—7½.
Liverpool Electric Supply, £5 (fully paid), 7½—8.
London Electric Supply Corporation, £5 Ordinary, ⅜—⅝.
Yorkshire House-to-House Electricity Company, £5 Ordinary Shares fully paid, 5½—6½.

Bank rate of discount, 2 per cent. (February 22nd, 1894).

NOTES ON SUBMARINE TELEGRAPH CABLE WORK.

Under the above title a pamphlet has recently been written and published privately by Mr. Walter Goodsall, late commander of the Eastern Telegraph Company's ss. *Chiltern*, dealing more particularly with the subject of grappling. There has been very little written on this subject, or indeed on anything connected with submarine telegraphy by men who are thoroughly conversant with the practical part of the work, and Mr. Goodsall's pamphlet is therefore all the more valuable. In describing grappling operations, extracts from diaries are given, and though no doubt the particular operations detailed are picked ones, Mr. Goodsall may well feel proud of them. The first instance given is that of a repair in the Bay of Biscay, in which the ss. *John Pender* was told off to assist the ss. *Chiltern*. Both ships left Portland Roads together, but owing to her superior speed, the *Chiltern* soon left her consort behind. Having run the course and distance calculated to place her on the ground of the break, and the position having been verified by observations for longitude, she put down a mark buoy in 412 fathoms, rocky bottom, and grappling was commenced at 8.50 a.m. At 11.35 a.m. the cable was hooked, and by 2.40 p.m. the *Chiltern* was merrily paying out cable towards a position 215 miles distant before the *John Pender* arrived on the scene.

In another instance, which is given to illustrate the value of placing the mark buoy as accurately as possible, on raising the moorings the cable was brought to the surface on the mushroom. When this sort of thing happens, we are always inclined to think that the buoy has been dragging its moorings, and not that it was necessarily put down right on top of the cable. *Apropos* to buoys, a capital plan, which is not mentioned, is to place a danger circle on the working chart round each buoy as it is put down, to indicate within what limits the buoy may possibly range from its mushroom under the influence of currents. One is apt to forget that a buoy put down in 1,000 fathoms of water, with 1,200 fathoms of moorings can range over a circle of over a mile diameter, and should therefore not be approached during grappling or cable laying within that distance.

Some interesting details are given of the uses of different grapnels. An illustration shows the pitiable condition in which a certain self-relieving grapnel came up with not only all its prongs broken off, but also a large portion of the boss. Of course, there are cases in which no grapnel can escape damage. It may become so jambed between rocks that if it did not break something else would, but we venture to say that when any well-designed grapnel of the self-relieving kind fails, the fault as often lies with those who are responsible for its adjustment and good condition, as in the grapnel itself.

Somewhat unkindly, perhaps, Mr. Goodsall gives the old history of the *Great Eastern* and the *Hibernia* and the lost grapnel rope. It is scarcely necessary to be reminded that if a long length of rope is lost overboard and grappling carried on in the neighbourhood, there is considerable likelihood of the rope being hooked, and this particular illustration of the fact might well be left in peace.

On the last page of the pamphlet the author gives his views on the Pacific cable question. He says: "It is as easy to pick up a cable in 3,500 fathoms in 1895 as it was to recover one in 500 fathoms in 1865, provided adequate safeguards and precautions are taken when the cable is being laid. The cable should be of the best materials, and laid with a proper allowance for slack." We quite agree with him that there should be no difficulty in picking up a properly designed and constructed cable in 3,500 fathoms, but what has the slack question to do with it? Most engineers consider that very little slack, if any, is wanted in great depths.

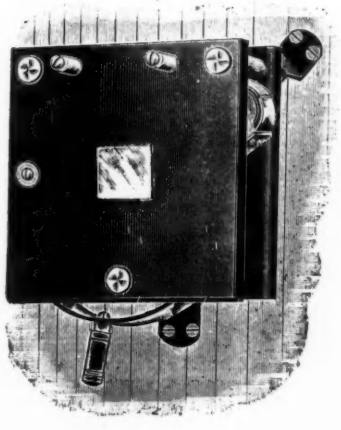
The following sentence, too, is a little startling:—"It cannot be too strongly urged that any cable, no matter how long submerged, or at what depth, can be recovered with perseverance, suitable appliances, and skill." Perhaps so; but would the game be worth the candle?

There are several expressions of opinion contained in the pamphlet with which we differ, but as the extracts from diaries, on which they are based, are given, everyone is at liberty to form his conclusions, and the more matter of the sort published the better.

A NOVEL RHEOSTAT.

Motor-starting rheostats have become very important features in the electrical line, as the Board of Underwriters as well as city fire inspectors not only require their use wherever motors are used, but stipulate they shall be made to open the motor circuit automatically and be fire-proof. It is also required, says the *Western Electrician*, that a double-pole switch be placed between the main wires and the rheostat, and that this switch must always be opened after the motor is stopped to avoid the danger of fires from grounds, lightning and the like. This latter requirement has resulted in more or less disaster and annoyance, as the error is frequently made of closing the armature circuit before closing the switch or field circuit. Thus the full force of the current is suddenly thrown on the motor. Such mistakes result in the instantaneous short-circuiting of the system and blowing of the fuses at the power station, as they may be already loaded nearly to their full capacity, thereby temporarily disabling the entire system.

A device has been invented by John C. Fyfe of Chicago to meet the requirements of the underwriters and comply with the city inspection rules, at the same time obviating the possibility of such mistakes as those heretofore alluded to. This device is shown in the accompanying cuts. It is

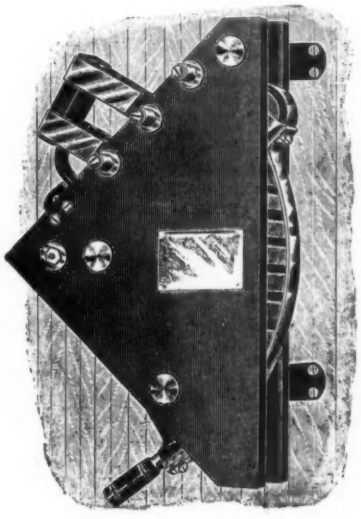


manufactured by the Hayes-Fyfe Company, whose headquarters are at 1,006, Pontiac Building, Chicago.

The primary object of the Fyfe motor-starting rheostat is to overcome the objectionable features referred to, and this is accomplished by providing a double-pole switch through which the circuit must be closed before the resistance and armature circuit can be closed.

The revolutionising feature of this improvement, however, lies in its being automatic in its release from any point of contact of the resistance, and the contacts being of iron, of great surface, are magnetised by being wound with the resistance itself. The resistance is insulated by an absolutely fireproof porous insulation, and is consequently perfectly ventilated but rigidly supported in every turn of the coils. Upon suspension of the current from any cause whatever, the multiplicity of rolling iron contact discs, carried by the contact arm at any point where they have been allowed to remain, become instantly released and fall by their own weight, not only opening the armature circuit but positively forcing open the double-pole switch after the initial magnetic resistance contact has been passed.

It will thus be seen that the motor may be operated at any required speed or power, and be automatic in release



from that point. The supporting of the fireproof ventilating resistance and the working parts within plates of slate, which are supported by thoroughly insulated iron feet, is sufficient proof of safety in operation. The liability to wear of the wearing parts of the device is reduced to a minimum.

REVIEW.

Jahrbuch der Elektrochemie. Berichte über die Fortschritte des Yahres, 1894. Halle, A. S., Verlag von Wilhelm Knapp. 1895.

The accumulation of scientific literature is fast becoming so great as to render it impossible for one man to keep up to date even in one science, without the assistance of the abstract and the index. Our scientific societies have lately been bestirring themselves in this direction, and the chemical and the physical societies are doing good work for their respective sciences. Germany is, however, still *facile princeps* in this field of specialised literature; while we can produce but a single year book of science, Germany has at least half-a-dozen in chemistry alone.

The book before us is a very good example of the kind in question, devoted to the somewhat restricted, though by no means unimportant field of electro-chemistry. The subject is treated in two main divisions, scientific electro-chemistry by Dr. W. Nernst, and applied electro-chemistry by Dr. W. Borchers. Dr. Nernst's summary of the latest advances in electro-chemical theory is admirably clear, though it is restricted to giving an account of the theories on this subject that have been adopted and developed principally by Ostwald, Nernst and others on the Continent, but which have not yet found general acceptance with us.

This electro-chemical theory is founded on the theory of solutions worked out by Van t' Hoff and Arrhenius. Van t' Hoff discovered that when a salt is dissolved in a liquid, the osmotic pressure is the same as if the salt was in the gaseous condition at the existing temperature and volume, and may, in fact, be calculated by the well-known formula for gases, $P V = R T$. This formula, however, was found to hold strictly only for concentrated solutions, and Arrhenius made the supplementary hypothesis that in dilute solutions the molecules of the salt in solution were dissociated or split up into atoms, which, according to the formula given above, would have the effect of doubling the osmotic pressure.

Every degree of dissociation can thus be obtained between concentration and infinite dilution.

Now, according to this theory of electrolysis, the passage of electricity through an electrolyte can only take place by means of the dissociated molecules or ions; and it follows from this that the electric conductivity of an electrolyte is a measure of the amount of the salt that has been dissociated by solution. Still another assumption has to be made to explain the motion of the ions in the electrostatic field between the electrodes; the metallic, or so-called positive ions, are supposed to have charges of positive electricity; the metalloid, or negative ions, are supposed to have charges of negative electricity. With this hypothetical mechanism, we can see that the metallic ions will move towards the cathode, and the metalloid ions towards the anode. Space forbids us to discuss further this interesting theory; the exposition in this work is one of the simplest we have seen; the only obscure sentence we have found is when the author explains the principle of Arrhenius by saying that "it is necessary to assume that there is double the number of molecules in the solution, *i.e.*, a dissociation of the potassic chloride into two new molecules." Now, the splitting of a molecule of potassic chloride into two new molecules does not quite hang together with our notions of chemical theory.

The section of the book on applied electro-chemistry by Dr. Borchers is full of interesting matter. His remarks on his own fuel battery, which some time ago excited so much interest, cannot be said to be over sanguine. He says: "Experiments with gaseous fuel have given better results (than with coal). The electrolyte used, a solution of cuprous chloride, remains practically unchanged; no great current was obtained with the experimental apparatus used, and if with improved apparatus, currents of higher electromotive force are not obtained, the cost of the installation for large undertakings will be too great; still it is to be remembered that the process and apparatus are yet in the initial stage of their development, and, as was pointed out in my first communication, they at least give encouragement to continue experiments in this direction."

On the commercial aspect of the manufacture of calcic carbide in the electric furnace, Dr. Borchers's opinion appears to coincide very much with that already expressed in the Electrical Review. In criticising Mr. Willson's estimate of the cost of 1,000 kg. (about a ton) of calcic carbide, he finds from his own experiments that 450 to 480 E.H.P. will be required for 12 hours, whereas in Mr. Willson's estimate 202 H.P. is considered sufficient. Several other items in Willson's estimate (which brings out the cost of a ton of the carbide as £3 10s.) are considered by Borchers to be fixed too low. He considers also that, in view of the work of previous investigators on this subject, neither M. Moissan's nor Mr. Willson's processes are patentable.

The subject matter of this book is well arranged and illustrated, and as far as we have been able to examine it, complete. It is also furnished with useful subject and name indexes. Those interested in the important industries connected with electro-chemistry could not do better than consult it.

THE EFFECT OF SMALL MOTORS ON FACTORY LIFE.

Referring to the introduction of late years of small motors of an economical order, the *Revue Général des Sciences* remarks that after many years, during which engineers have been devoting their entire energies to the perfection and manufacture of large power units, they have now turned their attention to motors of small power, yet economical, and our contemporary looks upon this as an augury for a better social condition in the future. Our century has, it says, witnessed the rise of the great factory which every day engulfs in its maw hundreds of workers of both sexes, and states that experience has proved clearly that the result on the manners and morals of the workers has been anything but good, nor have they benefitted on the score of health. That these remarks are true there can be no doubt in the mind of anyone who has had experience of the working of a large factory where the promiscuous aggregation of individuals of every variety of moral fibre produces effects exceedingly harmful on the more refined and weakly. The old system of home work, even when not conducted under the restrictions that could and would now be applied, was infinitely superior, and one may still see in some of the flannel manufacturing towns of the North of England houses still standing whose attic floor was specially built for the accommodation of the home weaver, the click of whose shuttles the writer has heard even himself. But these looms were hand looms only and could not compete with the power loom, and so the factory grew up with its attendant evils and economies, and undoubtedly there are many industries where the factory system is still obligatory. At the same time there are numerous industries where it is not necessary. Take, for example, the watch manufacture. In this most specialised of all trades a man has a small lathe and on it he works the year round at exactly the same job. The whole of the work he can do in a week he could carry to and from head-quarters in a handbag. Is there any reason why this man should walk to and from his work twice a day in all sorts of weather when one such journey in a week, or in a month it may be, would be all that was necessary? Even when necessary to reset the machine, a job done by the foreman, there would be economy in the home work, whether such setting involved a visit from the foreman or the actual conveyance of the little machine to the works. Thus the small motor has again brought forward the possible re-establishment of the small factory. This cannot be worked economically by a steam engine. The steam engine with its boiler and dangerous qualities in small badly attended units is quite out of the question for small motive powers, but the gas or oil engine is eminently useful. But there is no gas or oil engine of very much good for small home industries. For this purpose the electric motor alone can be relied upon. Clean, quiet, safe, and inoffensive, the electric motor offers the one means of driving machinery in a workman's house that can easily be adopted. Water-power could be employed, but the laying of high pressure mains would be costly, or the jet turbine is an exceedingly useful and reliable machine. But the electric motor can be driven from the same source as finds light, and the creation of home industries would find a day load for the lighting station.

In agriculture our contemporary remarks that modern progress has not done much to put the industry on a good footing, and agricultural machines, though only needed for small power are of clumsy build and cumbrous. The trials last year at Meaux of various petroleum engines were interesting to agriculturalists. The motors were all tried with the same petroleum of flashing point about 800° to 850° C., running light and at 2 hours, 4 hours, and full power, and their respective efficiency is given at from 7½ to 17 per cent., the smaller efficiencies being due to too great cooling or too much air. Useful, however, as we believe the oil engine to be for agricultural work, we cannot see that its place is in the supplying of power for home industries. This field can only be cultivated by the electric motor. In the course of the article a new form of brake is described, of which we hope soon to give a description. It is that of M. Ringelmann, and possesses some novel features.

NOVEL STEAM BOILER IMPROVEMENTS.

Under this head *L'Industrie Electrique* introduces two novel systems of steam generators. One of these, the Systeme Dubiau, we have already briefly noted (June 28th, 1895, at page 818), from the descriptive pamphlet of M. Hyppolyte Fontaine, whence we gather that its basis is improved circulation—indeed a very rapid circulation is claimed, and with considerable reason, so far as we can judge from the arrangements provided for the purpose.

The other improvement is that of the Systeme Solignac and is a revival of an old idea of very far back. It consists essentially of an upper vessel of water not directly exposed to fire, and of a system of small tubes in the furnace directly exposed to the fiercest heat. The contents of the whole once heated to a pressure of about 1 kilo. per cm^2, there is started a feed pump, which draws the heated water from the container, in which it is claimed the lime salts will all deposit as mud, not as scale, and forces this through small openings into tubes exposed to the fire. The water enters as a mist, it is spoken of by our contemporary as pulverised, and it gathers heat in its passage through the tubes and finally escapes—probably thoroughly superheated—into the water vessel below water level, giving up any excess of temperature to the water and becoming at once, no doubt, saturated steam. In passing to the water container the steam has to pass a check valve, and in event of any tube failing there can never be a large out-pouring of water. Steam alone will escape from the small broken tube and no accident will arise. As to the proportions necessary it is stated that to carry the heat for evaporating 100 kilos. of water in the reservoir there must be 100 kilos. of steam passing to the water and giving up its heat to the water. For this the sectional area of tube necessary is that of one tube of 35 mm. diameter. Double this is actually employed or four tubes of 24 mm. each. The water vaporises very quickly because of the rapid circulation and the result is obtained of 100 k. vaporisation per metre square of surface and an efficiency of 8 k. per kilogramme of fuel.

The bundle of tubes is thus reduced to very small proportions as compared with ordinary multitubular boilers, both by reason of the fewness and smallness of the tubes as well as their shortness, and the heating surface is but a tenth of that of ordinary boilers. The total volume is thus very small: each element of the vaporiser represents hardly two litres capacity and produces about 30 kilogrammes of steam per hour, or, in other words the evaporation is 15 times the water contents. It is always possible to make the bundle of tubes as powerful as one desires and this independently of the capacity of the water vessel. It is claimed that the pressure is maintained regular because of the storage capacity of the water in the reservoir, though how this can be is not very clear with so small a volume of water relatively to the total evaporative power, this latter implying also a large steam demand. The intensity of the fire may it is said be increased with safety, an elasticity useful in case of a forced

draught, the same boiler supporting very different rates of work without inconvenience.

The system enables the augmentation at small cost of the power of boilers by the addition of a tubular vaporiser on this system to already installed boilers, simply filling the old flues and furnaces with sand or other refractory non-conducting substance. As above stated, the water reservoir serves as a collector of lime salts, which will not form crusts but can be blown off when collected to sufficient amount as mud, and there is no danger, moreover, likely to arise from low water. Indeed the water level can be allowed to drop if a heavy draught of steam is required, and may be raised again to avoid excess of steam afterwards. This system, in its results is not altogether unlike that of the McPhail superheater applied to a badly priming boiler; the difference being in the final disposition of the steam only. A test made with one of these new boilers gave the following results.

The data were:—

Grate surface	1 m^2
* Heating surface	6·1 m^2
Tube diameter int.	24 mm.
„ „ ext.	30 „
„ number	30
Diameter of chimney	590 mm.
Pressure	5 kg. per cm^2
Feed temperature	5° C.

And the results attained were:—

Evaporation	650 k. per hour.
Fuel consumed	75·6 k. „
Ash produced	7·5 k. „
Combustible	68 k. „
Evaporation per square metre of heating surface	100 k. „
Per kg. of fuel	8·6 kg.
Per kg. of combustible	9·5 kg.

These figures are of great interest if they can be relied upon as easy to be reproduced. Much must necessarily depend upon the life of the tubes exposed to the furnace. If the above duty has been obtained it is striking testimony to the rapidity characterising the heat exchanges between hot and cold bodies, and a powerful argument in favour of the theory for cylinder reactions, as well as of the importance of rapid circulation when heating so poor a conductor of heat as water.

CATAPHORESIS AND SOLUTIONS OF H_2O_2 FOR BLEACHING TEETH, &c.†

By WILLIAM J. MORTON, M.D., New York, N.Y.
Professor of Diseases of the Mind and Nervous System and Electrotherapeutics at the New York Post-Graduate Medical School and Hospital.

By cataphoresis is meant the movement of fluids, together with the substances they may hold in solution, from the positive pole of electrodes conveying a continuous current in tissue, toward the negative pole. As signified by the derivation of the word "cataphoresis," the substance held in solution "goes down" with the current, that is to say, moves with its ordinarily accepted direction of flow, just as in electroplating the metal held in solution goes down, *i.e.*, from a higher to a lower potential, and is deposited on the negative electrode or cathode. This comparison to what takes place in electroplating might lead us to believe that cataphoric action was due to electrolysis, and it must be admitted that electrolytic and cataphoric action are not yet differentiated with sufficient clearness. But there is little reason to doubt that one action is as distinctive a property of the continuous current as the other. And, without entering into the reasons for this statement, it is enough to affirm, for all practical purposes, that fluids in tissue do move from the positive to the negative electrode. But there are exceptions even to this statement, for eosin travels from negative to positive, as also does an alcoholic solution of bromide of barium.

So much, in a brief way, for cataphoresis—the general principle. Should we desire to make use of this principle to introduce medicines into human tissue, we may refer to the procedure as cataphoric medication. And to avoid confusion and theory, and the contradiction that some substances in solution travel upward rather than downward, I have proposed the terms electric diffusion and electric medicamental diffusion. These terms at least express the facts.

To secure successful electric medicamental diffusion, several important points may here be noted.

(*a*) The medicine in solution must be brought into intimate contact with the tissue, in order to constitute with it a comparatively continuous electrolyte.

(*b*) Metallic conduction (of the electrode, the positive pole) must end very close to where electrolytic conduction begins; that is to say, the absorbent material holding the solution must be thin, and allow the metal electrode to come as near as possible to the tissue.

(*c*) The negative electrode must be removed to a distant point.

(*d*) If the tissue to be treated is the skin, it must be well washed with soap and water, or ether or alcohol, to remove the natural oils.

(*e*) The solution used must be of neither too high a resistance nor of too low. If too high, like alcohol, ether, or chloroform, no current will be conducted; if too low, like a saturated solution of common salt, cataphoric effects will not be pronounced.

* The heating surface is measured inside the small tubes.

† From the Philadelphia *Dental Cosmos*.

With a view of ascertaining if discoloured teeth could be actually and practically bleached by cataphoric medication, I performed the following experiments, assisted by Mr. Wm. J. Evans, of McKesson and Robbins, who kindly supplied the teeth, the pyrozone and other chemicals required. But first, a word as to the necessary outfit. This should constitute (*a*) a galvanic battery of at least 40 Leclanché cells, or of 30 red acid or Poggendorf cells, as sold in the ordinary portable battery, for a voltage of at least 60 volts is required; (*b*) a rheostat; (*c*) a milliampèremeter, and (*d*) a needle-holder for platinum wire.

The experiments were as follows, omitting numerous ones made for control, or those affording no definite results:—

The first point was to establish if solutions of H_2O_2 would conduct electricity.

Experiment 1.—H_2O_2 25 per cent., plus sulphuric ether 75 per cent. A few drops laid upon a glass plate, platinum wire electrodes placed ½-inch apart, 40 cells equalling about 60 volts, gave only about 1 milliampère of current, a current strength too small for practical work.

Similar solutions of the same strength of H_2O_2 in chloroform, glycerol and distilled water gave in the first two instances no current, and in the latter about 2 milliampères.

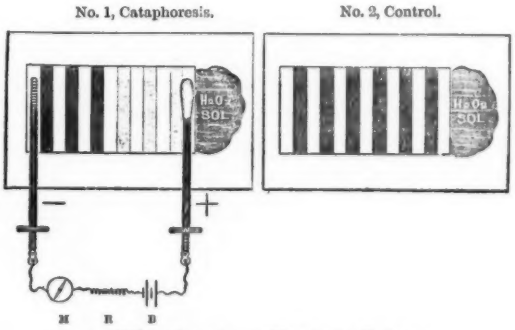
Experiment 6.—H_2O_2 25 per cent., plus sulphuric ether 75 per cent., plus dilute sulphuric acid a mere trace, gave 20 milliampères, namely, sufficient for practical work if so desired.

Experiment 8.—H_2O_2 25 per cent., plus sulphuric ether 75 per cent., plus solution of chloride of sodium, afforded electric conduction, but the solutions did not mix, and therefore were impracticable to work with in that form.

Experiment 11.—A molar tooth containing a large cavity, leaving half of its crown still intact. The enamel of the crown was badly discoloured by organic decomposition; the central divisions of the dentinal tubuli were well exposed; contrast was made by comparing it with another tooth to match the colour, so that the shade could be determined. Cavity packed with absorbent cotton; rubber-dam adjusted, and the roots of the tooth imbedded in a piece of beef meat. Cotton was tightly wound about the platinum wire, constituting the positive electrode; the negative was another wire inserted into the beef about 1 inch away from the imbedded tooth.

Solution of chloride of sodium ⅔ths of a cubic centimetre, and 1 and ⅔ths cubic centimetre of H_2O_2 25 per cent., water 75 per cent., made by shaking two parts of pyrozone 25 per cent. solution with one part of water, and separating the fluids in a funnel, was dropped on to the cotton with a pipette; the current was turned on and very quickly dried it, which was indicated promptly by the fall of the needle of the milliampèremeter, and more solution was continuously added. The darkened portion of the tooth bleached perceptibly white within a minute; current strength 25 milliampères. Then about the same number of milliampères was employed during five minutes; enamel perfectly bleached. The bleaching action was also evident at the ends of the roots of the tooth, the H_2O_2 having been conveyed there by way of the open pulp canals. These latter therefore, in actual practice, if exposed, should be closed by a non-conducting cement.

Experiment 12.—Two pieces of blotting paper, 1 × 2 inches, each laid on a glass plate, and six bars of blue litmus paper laid across the blotting paper thus:—



M, Milliampèremeter; R, Rheostat; B, Battery.

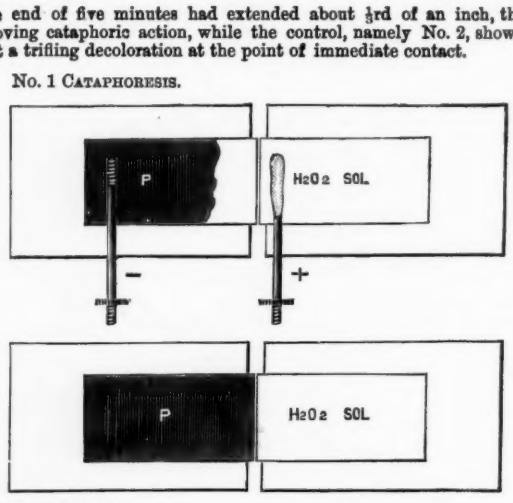
Two cubic centimetres of 25 per cent. aqueous solution H_2O_2 applied on glass at end of blotting paper; 50 milliampères current. Blotting paper wet with a weak solution of chloride of sodium; current turned on. Almost immediately in No. 1 the litmus paper at the positive end began to bleach, and this bleaching progressed in perceptible steps towards the centre, until within 4½ minutes the litmus paper on the positive end (three bars of it) was completely bleached of its blue colour. The control experiment showed no change, proving that ordinary diffusion or chemical osmosis was not the cause of the result obtained in No. 1.

Experiment 13.—Four pieces of blotting paper, 1 × 2 inches, two pieces saturated with a decinormal solution of permanganate of potassium, U.S.P.—this stained them a chocolate colour; two pieces saturated with 25 per cent. aqueous solution of H_2O_2. Each piece of permanganate paper was brought into juxtaposition with each piece of H_2O_2 paper. No. 1 for cataphoresis: No. 2 for control (see illustration).

The H_2O_2 pieces of blotting paper were previously moistened with a solution of sulphate of soda; 50 milliampères of current strength were applied as indicated by the platinum electrodes in the illustration. The encroachment of decolorisation of the permanganate paper was noticed at once in No. 1; it progressed steadily, and at

the end of five minutes had extended about ⅛rd of an inch, thus proving cataphoric action, while the control, namely No. 2, showed but a trifling decoloration at the point of immediate contact.

No. 1 Cataphoresis.



No. 2 Control.

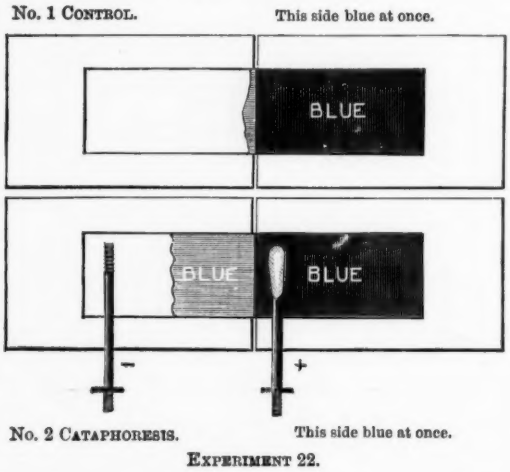
P, Permanganate solution.

Experiment 13.

Experiment 22.—Four pieces of blotting paper, each one 1 × 2 inches, were laid in pairs upon glass plates, so that the edges of each pair could be brought into contact. The blotting paper was wet with a solution of sulphate of soda. Then four pieces of ozone test paper of about the same size were laid upon the pieces of blotting paper, the ozone paper in this way becoming slightly moist with the solution beneath it. This white ozone paper gives a bright blue reaction to H_2O_2.

See illustration, showing in No. 1 the control experiment, and in No. 2 the cataphoric effect which occurred, placing pyrozone, 25 per cent. solution ethereal, upon the right-hand papers. These, of course, were immediately coloured blue. The pieces of glass were now so moved as to permit the pieces of paper to touch, and in No. 2 the current was turned on up to 50 milliampères.

No. 1 Control. This side blue at once.



No. 2 Cataphoresis. This side blue at once.

Experiment 22.

The result was most striking and most conclusive, for the H_2O_2 solution under the electric influence straightway began to invade the previously white paper and coloured it blue for half of the distance toward the negative electrode, while in the control experiment little or no blue colour was produced upon the white paper, except for a trifling distance from the point of contact.

Conclusions.

1. Cataphoric action is a demonstrable property of the galvanic or continuous current.

2. The negative pole must be placed at some part of the body comparatively distant from the tooth, for instance the cheek, hand, back, or breast.

3. The pulp canals, if exposed, should be closed by a non-conducting cement.

4. Solutions for cataphoric action should, if spirituous, aqueous, or with glycerol, be associated with some substance which makes them better conductors of electricity.

5. Experiment 22 teaches this most important fact, namely, that while ethereal solutions of H_2O_2 do not conduct electricity, and cannot therefore be used by themselves for cataphoric action, still this effect can be readily obtained when the porous material which holds such an ethereal solution has been previously moistened with a solution of sulphate of soda or some similar conductor.

6. The efficacy of bleaching agencies, as, for instance, H_2O_2 solutions, is greatly enhanced by the concomitant aid of electricity, namely, by cataphoresis.

THE CAUSE OF DEATH IN ELECTRIC SHOCK.*

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The work here given was undertaken with a view to elucidating the effects of larger quantities of electricity on the organism. Incidentally the value of artificial respiration after death by electricity was also tested. As this is the minor portion of the work this part will be given first.

The data bearing on the subject in general are quite meagre, especially as to the amount of current which actually passed through in fatal cases.

In all my experiments dogs were used, and in the subjoined table the weight, voltage, ampèrage and time are given for each case.

In the first experiment 525 volts, 2 ampères were applied for 8 seconds; in the second, 220 volts, 1·2 ampères; in the third, 106 volts ·4 ampère, 10 seconds; in the fifth, 96 volts ·35 ampère, 2 seconds; in the sixth, 52 volts ·3 ampère for 1, 2, and 4 seconds; in the seventh, 70 volts ·32 ampère, ½, 1, and 2 seconds, were used.

Before the application of the current a canuala was put into the trachea so arranged that it could at once be connected with a bellows for the purpose of giving very complete artificial respiration. Respiration was set up as soon as the current was off and this was continued for periods varying from 20 minutes in the first case to 2½ hours in the last, and in no instance was resuscitation accomplished.

Further work was carried on for the sole object of studying the effect of the current.

Our electrodes consisted of oval copper plates 3 by 2 inches, covered with sponges moistened with salt water. One electrode was applied at the base of the skull, and the other over the middle of the back, the hair of the animal having been previously well moistened with the salt solution. The current used was the alternating current of 130 periods per second. While the details of each experiment are given in the table subjoined, a few are selected for special presenta-

Data on the Cause of Death in Electric Shock.

No.	Weight (lbs.)	Volts.	Amperes.	Time (seconds)	
1	21	525	2	8	Artificial respiration 40 min.—Death.
2	15	220	1·2	8	Artificial respiration 25 min.—Death.
3	30	106	·4	10	Artificial respiration 1 hr. 15 min.—Death.
4	42	98	·4	4	Artificial respiration 2 hrs. 30 min.—Death.
5	27	96	·3	2	Artificial respiration 1 hr.—Death.
6	21½	52	·3	1	Recovery.
				2	Recovery.
				4	Death.
7	12	70	·32	·5	Recovery.
				1	Recovery.
				1	Recovery.
				2	Recovery.
8	40	47·5	·25	4	Death.
9	35	96	·35	1	Death.
10	30	52	·25	2	1-30 grain atropine—Recovery.
				4	1-30 grain atropine—Death.
11	28	52	·29	2	3-60 grain atropine—Recovery.
				4	3-60 grain atropine—Death.
12	26	50	·24	4	1-25 grain nitroglycerine.—Recovery.
		97	·54	1	1-25 grain nitroglycerine.—Death.
13	30	48	·22	4	1-20 grain nitroglycerine—Death.
14	33	52	·22	4	4-50 grain nitroglycerine.—Recovery.
		104	·6	4	4-50 grain nitroglycerine.—Death.
15	22	51	·32	4	6-50 grain nitroglycerine—Death.
16	22	47	·2	4	1-10 grain nitroglycerine—Death.
17	27	52	·2	4	1-10 grain nitroglycerine.—Recovery.
		106	·55	1	1-10 grain nitroglycerine.—Death.
18	36	51	·25	4	80 grains chloral, 1-50 grain atropine—Death.
19	30	52	·24	3	Death.
20	51	52	·24	3	Recovery.
			·25	4	Recovery.
			·30	6	Death. (22 deep respirations.)
21	25	50·5	·2	3	Death.
22	19	51	·2	3	Small dose nitrite of amyl.—Death.
23	17	51	·2	3	Small dose nitrite.—Death.
24	34	50·5	·2	3	Full dose nitrite.—Recovery.
				6	Full dose nitrite.—Recovery.
25	38	50·5	·2	4	Recovery.
		101	·2	6	Recovery.
			·5	1	Death.
26	34	51	·12	4	Recovery.
			·18	4	Recovery.
			·2	4	Death.
27	12	50	·2	4	Full dose nitrite.—Recovery.
				6	Full dose nitrite.—Death.

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tion. The larger voltages were abandoned for 100 volts, 70, and 50, as near as could be reached.

Ninety-eight volts with ·32 ampére were applied first ½ second, then 1 second with recovery, but in 2 seconds produced death. Fifty-two volts with ·3 ampére were applied 1 second, later 2 seconds, with recovery, then 4 seconds, producing death. Fifty-two volts ·24 ampére applied 3 seconds produced death. Fifty-one volts ·12 ampére, 4 seconds; 51 volts ·18 ampére, 4 seconds were not fatal. Fifty-one volts ·2 ampére, 4 seconds produced death. From these figures and similar ones to be obtained from the table, it is evident that the result depends, somewhat independently of the weight of the animal, on three factors: On the voltage, on the ampérage, and upon the time of application. A variation of any one of these factors may change the result—that is, a lower voltage with lesser ampérage applied for a longer time will have the same effect as a current of higher voltage or more ampérage applied for a shorter time. In this connection it was suggested by Professor Thomas that the joules necessary would be found the same in each case, and calculations show that this is approximately true. To prove this absolutely it would, of course, be necessary to work with the minimum quantities as to voltage, ampèrage and time in each case, and no doubt one or another of these factors will be found in excess in most cases. In these experiments it is of great interest to point out this approximate relation between the results and the absolute amount of mechanical energy used. The results found on post mortem examination of the animals were so uniform that they can be very briefly described. In all cases this examination was made immediately after death, and at first we wished to study the changes produced upon the heart, so that the incision was made through the chest walls and the heart exposed as rapidly as possible. This organ presented the following peculiar conditions: The left side was completely relaxed, the right side was intensely gorged with blood, as were also the large veins in the immediate vicinity of the heart, and the little appendages of the upper portion of the heart were found beating regularly, strongly and synchronously. Pressure on the heart caused a contraction of the other parts, and from this it was evident that death was not due primarily to the destruction of the heart fibres. In addition it was noted that the deep and extensive cuts made in the tissues were free from blood, and that the arteries were quite small and contracted.

This excluded a direct effect upon the heart, and having shown by artificial respiration that the stoppage of this function was not the cause of death, other causes were to be looked for.

It was supposed that the current immediately struck the pneumogastric nerve, stimulating those fibres which control the heart, in that they have the power of arresting its beat when strongly stimulated. To test this view resort was had to the hypodermic injection of atropine, the action of which drug is to paralyse the nerve fibres, and thus prevent their action on the heart when stimulated. In one case $1\frac{1}{30}$th grain of atropine was given; 52 volts with ·25 ampère were applied first for two seconds, then for four seconds, and this resulted in death. In a second case $\frac{1}{30}$th grain of atropine was given; 52 volts with ·29 ampère were applied first two seconds, then four seconds, again resulting in death. These animals were not therefore rendered more resistant by the drug, and the theory as to the rola of the pneumogastric nerve was abandoned.

I now recall the fact already mentioned that after death incisions into the animal are not followed by bleeding, that the arteries are contracted down to a very small calibre, and that the blood is crowded into the very large veins in the trunk. Taking these facts, it was suggested that the current acted upon the arteries through the nervous centre which controls their diameter. It is well known that the arteries are supplied with a middle muscular coat in which the fibres are circular, and their contraction would, of course, cause a narrowing of the artery, rise of the blood pressure, and a consequent impediment of the heart's action; in fact, it has been experimentally demonstrated that the arteries can be constricted to such an extent as to produce a rise of blood pressure which the heart is unable to overcome, and that the circulation will stop from this cause. It is further known that we have in the brain most of the nerve matter whose function it is to control the vaso-motor nerves, the arteries at one time and in one place contracting, and thus decreasing the amount of blood; at another time and in another place dilating, and thus increasing the amount of blood getting to another particular part. To test this view, that the action of the vascular nervous system was the cause of death, we resorted to the hypodermic use of nitroglycerine. It is known of this drug that it powerfully affects the arterial system, causing, when given in large doses, an extreme dilitation of the arteries, and a consequent great lowering of the blood pressure.

The first animal received $\frac{1}{75}$th of a grain of nitroglycerine, and when the effects were fully established, a current which was known to be fatal was thrown in—namely, 50 volts ·24 ampère for 4 seconds—but the effects produced by this current soon passed off, and there was complete recovery. Then 97 volts with ·54 ampère were thrown in for 1 second, but this caused death. In another case $\frac{3}{75}$ths of a grain of nitroglycerine was used. Here 25 volts ·22 ampère, a fatal dose, were thrown in for 4 seconds with recovery. 104 volts ·6 ampère were thrown in for 4 seconds, producing death; but after the current was taken off there was noted eight deep, although irregular, respirations. In other cases where the nitroglycerine was used there was no apparent effect, but some investigation led me to attribute this to the unreliability of the tablets of nitroglycerine used, and this drug was thus abandoned for nitrite of amyl, a substance which has the same physiological effects as nitroglycerine, but which can be always obtained pure, and the effects of which can be more accurately regulated because it is given by inhalation. In the first case the animal was brought moderately under the influence of the nitrite of amyl, 52 volts with ·24 ampère were thrown in for 3 seconds (this, by the way, being a fatal dose ordinarily) without producing death. 52 volts, ·25 of an ampère for 4 seconds, also a fatal dose, failed to produce death. 52 volts, ·3 of an ampère for 6 seconds produced death, but after the current was taken off, the animal made 22 deep, regular respirations, though not a trace of the heart-beat could be made out, this incidentally proving that stoppage of the respiration is not the primary cause of death.

Three more experiments may be selected:—Nos. 24, 26 and 27 of the table.

No. 24 was a pointer dog in excellent condition, weighing 34 lbs. Nitrite of amyl was given until the effects were fully marked. $50\frac{5}{10}$ths volts with ·2 ampère were given for 3 seconds; after a pause the same quantity was given for 6 seconds, followed by recovery. Three days later the same dog, who showed no effects at all of the previous treatment, was given—without the nitrite of amyl—51 volts 2 ampères, 4 seconds, producing death.

In the last case a dog weighing only 12 pounds and of such general condition of weakness that the assistant protested against his use as not being competent to demonstrate anything, was given a full dose of nitrite, then 50 volts with ·6 ampère were applied for 4 seconds and followed by recovery. The dose applied for 6 seconds produced death, and here again several respirations were noted.

The statements made in regard to the cause of death by electricity are so at variance with one another that it is unnecessary to review them here. Among other plausible reasons it has been stated that the current has a direct disintegrating effect on the brain and nerve tissues, and that herein is to be found the cause of the fatality. The disintegrating effects of the current on the brain and nerve tissues said to follow are not to be seen microscopically, and the microscopic examination of these organs, so far as made by us, failed to reveal any change in their structure. It would appear, therefore, that death in electric shock is entirely due to the fact that the current produces a contraction of the arteries through an influence on the nervous system, and that this constriction of the arteries throws in such a mechanical impediment to the flow of the blood, as the heart is unable to overcome, and that where drugs are given to counteract this effect, much larger doses of electricity than the ordinary can be borne. While artificial respiration may be of value in simple stunning, when larger doses have been taken no rational means of resuscitation have as yet been suggested.

I was enabled to carry out the above experiments by the loan of apparatus kindly furnished by Professor Thomas, and was greatly assisted in the work by Mr. Boyd, of the physical department, who was present at every experiment, and who made the measurements for us.

The current was obtained from a surface-wound alternator giving an approximate sine-curve. For potentials of 100 volts or less, connection was made with the secondary of a suitable transformer. Potentials of over 100 volts were taken direct from the primary circuit, adjustment being made by varying the generator field.

Voltages were measured by means of a Weston alternating current voltmeter. The mains supplying the current were of low resistance, so that the drop when the circuit was closed was found to be negligible. The figures given are the actual potential differences of the electrodes while the current was flowing through the animal, correct to within one-half volt. A Siemens dynamometer was used for measuring the current when the time of contact was less than four seconds. It was somewhat difficult to make a setting, so that readings for those short times cannot be taken as correct within five per cent.

NEW PATENTS—1895.

18,274A. "An improvement in electric arc lamps." J. BROCKIE. (Date claimed under Patents Rule 19, September 26th, 1894) Dated July 12th.

13,164. "Improvements in alternating-current dynamos." W. L. WISE. (Communicated by The Maschinenfabrik Oerlikon, Switzerland.) Dated July 8th.

13,168. "Improvements in electrical contact-making devices." R. MYERS. Dated July 8th.

13,205. "Improvements in electrical transmission of energy for signalling." M. I. PUPIN. Dated July 9th. (*Complete.*)

13,207. "Improvements connected with electric arc lamps." A. C. SEIBOLD, E. O. CLARK, and W. SOWDON. Dated July 9th. (*Complete.*)

13,255. "Improvements in apparatus for the electrolysis of oxides, salts, and other chemical compounds." J. B. TORRES. Dated July 9th.

13,274. "An improved arrangement for telephonic apparatus adapted to only register the conversations really held." F. QUATRAM and E. HILDEBRANDT. Dated July 9th.

13,285. "Improvements in electrical switches." M. ROHMANN. Dated July 10th.

13,303. "Improvements connected with arc lamps." E. A. PELLET. Dated July 10th.

13,312. "A rain-making contrivance to be used in conjunction with the barometer, hydrometer, electrometer, &c., under Government control by wire (telegraph)." H. P. MADSEN. Dated July 10th.

13,348. "Improved methods of distributing power by electricity." F. H. ROYCE and E. A. CLAREMONT. Dated June 11th. (*Complete.*)

13,380. "Improved electric lighting system for railway vehicles and dynamo therefor." M. MOSKOWITZ, L. D. ADLER, A. S. ADLER, and T. W. MYERS. Dated July 11th. (*Complete.*)

13,388. "Improvements in electric arc lamps." J. Devonshire. (Communicated by E. Thomson and C. E. Harthan, United States.) Dated July 11th. (*Complete.*)

13,389. "Improvements in methods of and means for regulating the speed of continuous current motors." J. Devonshire. (Communicated by M. J. Wightman, United States.) Dated July 11th. (*Complete.*)

13,404. "Improvements in dynamo-electric machinery." F. H. Royce and E. A. Claremont. Dated July 12th. (*Complete.*)

13,405. "Improvements in and relating to electric telephone systems." A. Marr. Dated July 12th. (*Complete.*)

13,410. "A binder for attaching telegraph and other aerial lines to their insulators." W. W. G. Webb and A. Eckstein. Dated July 12th.

13,411. "Improved methods of distributing power by electricity." F. H. Royce and E. A. Claremont. Dated July 12th. (*Complete.*)

13,416. "Improvements in electric lamps for stage-lighting." A. Walters. Dated July 12th. (*Complete.*)

13,425. "An improved process for the electro-deposition of aluminium alloys." C. Oppermann. Dated July 12th.

13,426. "An electric polishing machine." C. Oppermann. Dated July 12th.

13,434. "Improvements in the electrolytical production of zinc from its ores and apparatus therefor." Siemens Bros. & Co., Limited. (Communicated by Messrs. Siemens & Halske, Germany.) Dated July 12th. (*Complete.*)

13,436. "Improvements in electric light suspension fittings." L. B. Miller. Dated July 12th.

13,438. "Improvements in or relating to telephone switchboards and pushes or calling devices connected therewith." J. Stamm. Dated July 12th. (*Complete.*)

13,444. "Improvements in electrical heating apparatus." O. March. Dated July 12th.

13,459. "Improvements in the manufacture and production of electric cables or conductors." G. E. Heyl. Dated July 12th.

13,472. "An improved electric lighting system for road and railway vehicles." N. Gleboff. Dated July 12th.

13,483. "Improvements in dynamo-electric and electro-dynamic machines." C. Raleigh. Dated July 13th.

13,495. "An improved electrically illuminated curtain or drop for theatrical purposes." W. Holland. Dated July 13th.

13,530. "Improvements in telephones." A. Hamm, G. Blank, V. Brandt, and G. Kormendy. Dated July 13th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1894.

5,391. "Improvements in electric railways and tramways." W. Aldred. Dated March 15th. Relates to the improvement in the arrangement of apparatus for the distribution of the electric current to railways and tramways, and likewise shows the means by which telephonic communication can be worked while the cars are in motion. 4 claims.

7,132. "Improvements in microphones." H. Carbonnelle. Dated April 10th. Consists of a thin and flexible India-rubber tube, the orifices of which are closed by means of conducting tablets made of carbon or any other suitable material. The hollow space thus provided is filled with coke, or other material in a granulated or reduced condition. The microphone is free at one end, while the other end is connected to a vibrating membrane or diaphragm through the medium of a second India-rubber or other elastic tube, narrower and shorter than the first. 5 claims.

7,530. "An improvement in electrical glow lamps." The Edison and Swan United Electric Light Company, Limited, and J. M. Moffat. Dated April 16th. Relates to a simple and compact construction of switch in combination with the cap and socket of an electrical glow lamp, whereby a single filament, or the one or both of a pair of filaments in the bulb, can be put into or out of circuit with the conductors. 1 claim.

7,726. "New or improved mechanical and electrical appliance for regulating and controlling the charging of storage batteries, the supply of water to steam generators, and for other purposes." G. R. Rollason, C. A. Rollason, and W. H. Fletcher. Dated April 18th. Has for its object an improved appliance for automatically effecting the movement of a driving belt or rope from a fast to a loose pulley, and *vice versa*, the opening and closing of a valve, and for other analogous purposes, and which may consequently be utilised for governing the charging of storage batteries, the supply of water to steam generators, and for most purposes where controlling mechanism is requisite.

8,972. "Improvements in or relating to secondary batteries." F. Griffin. Dated May 5th. An electrode, according to this invention, is composed of suitable filling or active material held in an openwork frame or support, so shaped that one or each side of the electrode is formed by a series of ribs separated by grooves of the same, or approximately the same form, in cross section as the ribs, so that when two or more such electrodes are arranged in a cell, the ribs on one can partly enter the grooves in the other opposite to it—thereby enabling large active surfaces to be obtained in a comparatively small space. 3 claims.

9,123. "Improvements in and relating to electric railways." H. S. Maxim. Dated May 8th. The inventor provides motors on the engine or on the carriages of the train, and he supplies the current thereto from conductors extending alongside the rails. The prime movers and generators for producing the current are stationed at suitable intervals along the line. An important feature of the invention relates to the provision of means whereby only a comparatively small portion of the charged conductor is exposed to the air at any time. 7 claims.

9,285. "Improvements in or relating to electrodes, and method of manufacturing the same." C. Kellner. Dated May 10th. Relates to an arrangement in which electrodes of plate form are divided by a superposed partition into two halves, of which one acts electro-positively and the other electro-negatively, the several electrodes divided in this manner being arranged on the bottom of the electrolytic apparatus, and being separated by partitions of non-conducting material. 4 claims.

9,565. "Improvements in the metal screw, bolt, or other attachments for fixing insulators to carry electric wires." A. Gray. Dated May 16th. Consists in coating or encasing the screw bolt or other attachment with a plastic material now commonly called "Avonite," or some other non-conducting material, in such a manner as to allow the insulator to screw on or off the bolt, &c., or be made a fixture.

10,132. "Automatic zero-reading electrical instruments." J. Edmondson. Dated May 25th. Consists in the combination with any zero-reading electrical measuring instrument or apparatus for automatically adjusting the zero, and for continuously recording the amount of the adjustment so made, either in the form of a diagram or (by integration) on a dial or dials. 6 claims.

10,172. "Improvements in or connected with vehicles for electric railways or tramways." E. Hopkinson. Dated May 25th. The collecting bar, or bars or rollers, or the like is, or are, carried in such a manner that it, or they, can yield when necessary to pass an obstacle, and after passing the obstacle return to their normal position. This is most conveniently effected by giving it, or them, freedom of limited movement round a horizontal axis, and by providing a spring or springs, or other equivalent device, which serves or serve to maintain the said bar or bars or rollers, or the like, in its or their normal position, unless displaced as above-mentioned, and tend to immediately restore them to their normal position when so displaced. 1 claim.

10,332. "An improvement in regulating apparatus for electric arc lamps." S. J. Suter. Dated May 28th. Relates to a simple and compact clutch arrangement for this purpose. A clutch according to the invention consists of two blades lying horizontally side by side, each having a semicircular notch in its edge, the two notches forming a circular hole through which one of the carbon holders passes. The two blades are jointed together at the one end by a hinge which permits their other free ends to move up or down independently of each other. One of these ends is guided to move vertically, the other has projecting laterally from it a lug which is connected by a link to the core of a solenoid having its coil in the lamp circuit or to the lever connecting the cores of two solenoids, the one having its coil in the lamp circuit, the other having a high resistance coil in shunt. When the blade connected to the core or lever is moved upwards it is laterally canted, and the other blade being jointed to it, is also laterally canted so that the carbon holder is firmly clamped between the canted blades and rises with them, striking the arc; then, as the blade is gradually but partially lowered, the holder is also lowered, allowing the carbons to approach each other, until the hinge of the blades meets a stop and then their farther lowering allows the blades to resume their original position, without being laterally canted, so that they release the carbon holder which is then free to slide down feeding the carbons.

10,425. "Improvements in electrical transformers." J. A. Kingdon. Dated May 29th. The inventor constructs the cores of a transformer for alternating currents of thin iron or steel plates of a rectangular shape, having a rectangular opening stamped near their centres, so as to resemble to some extent the letter O. He employs two piles of these plates placed side by side. The windings of the primary and secondary coils pass up through the opening in one pile of plates, and down through the opening in the other pile of plates. 1 claim.

10,426. "Improvements in dynamo-electric machines." J. A. Kingdon. Dated May 29th. In the improved alternator the inventor employs a single exciting coil wound round an iron or steel magnet core. The ends of the magnet core are fixed to pole pieces of laminated iron, which are suitably shaped so as to partially surround the rotating inductor. The inductor consists of a drum of laminated iron or steel, mounted on a spindle, and having a number of iron or steel projections or teeth. 7 claims.

10,978. "Improvements in electric measuring instruments." W. T. Goolden and S. Evershed. Dated June 6th. Relates to ohmmeters used for the direct indication of electric resistance, and has for its object the removal of certain difficulties which are met with in the use of the several instruments for the same purpose which formed the subject of patent No. 2,694, 1889. 3 claims.

15,414. "Improvements in telephone systems." F. G. Warrell. Dated August 13th. The object of the invention is to provide a combined system of telephone and call bell annunciators for hotel, house, and other like purposes, of simple and inexpensive construction, so that the call indicated by the annunciator may be connected by telephone communication by the mere adjustment of the proper switch at the switchboard; and in which each of the respective terminals may be connected with the annunciator and central telephone on independent circuits. 2 claims.